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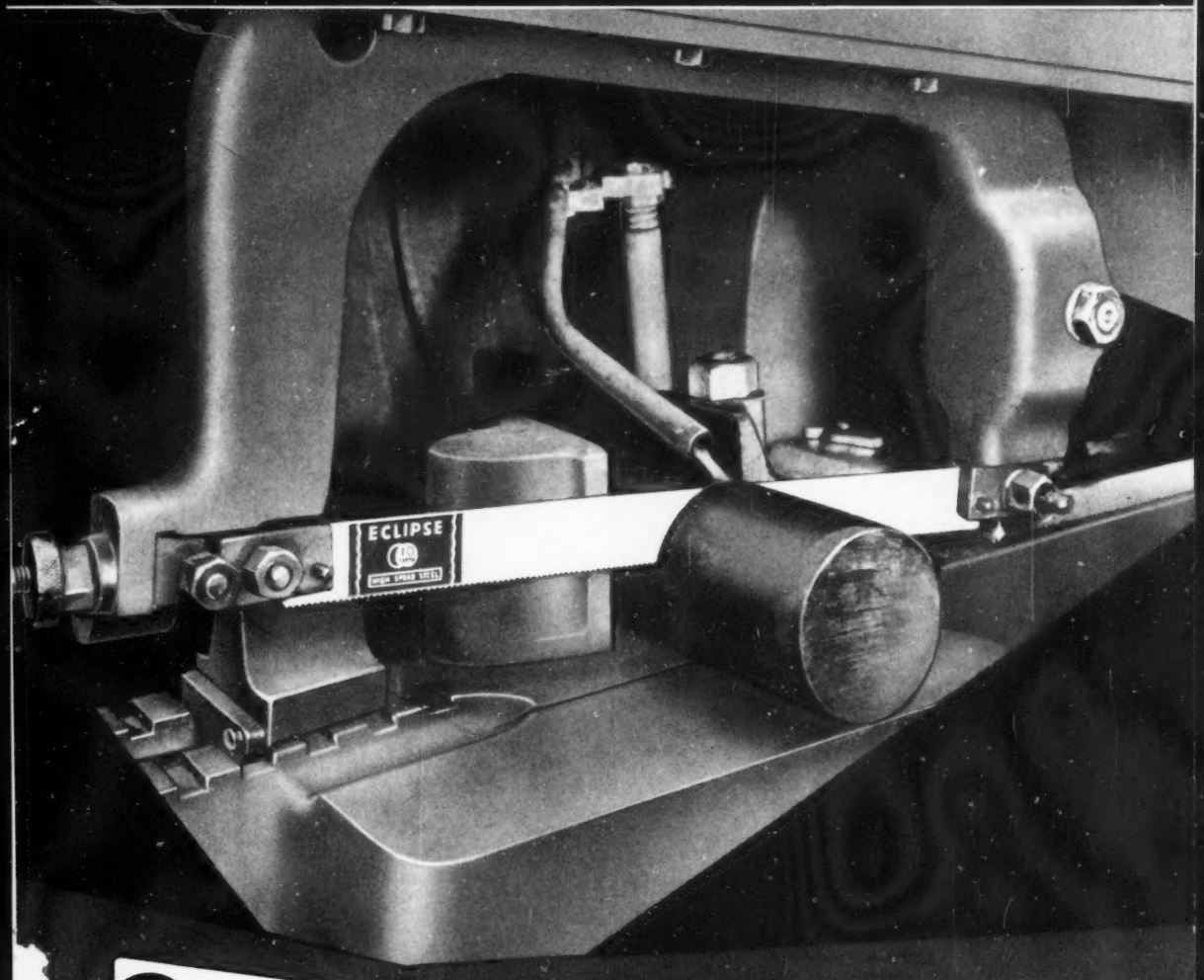

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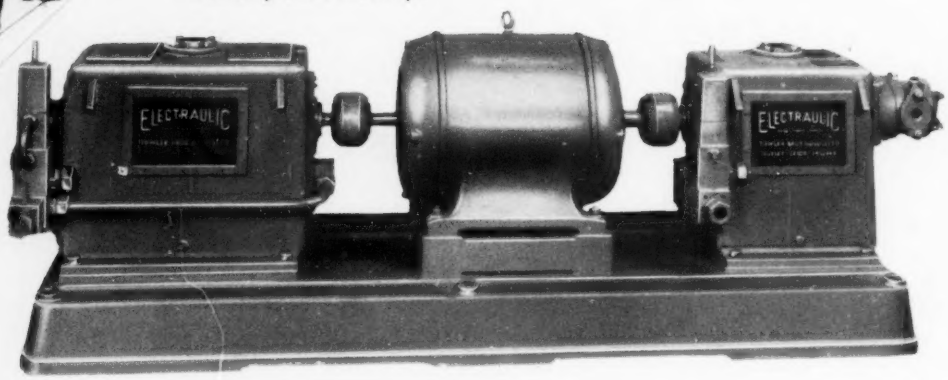

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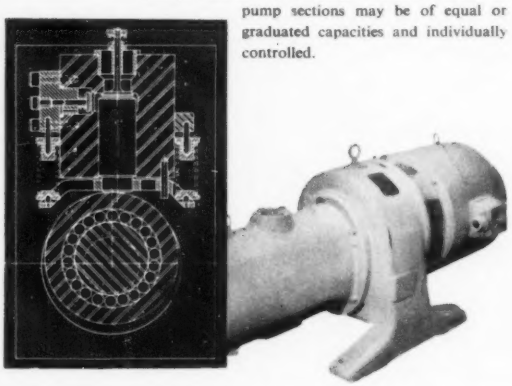

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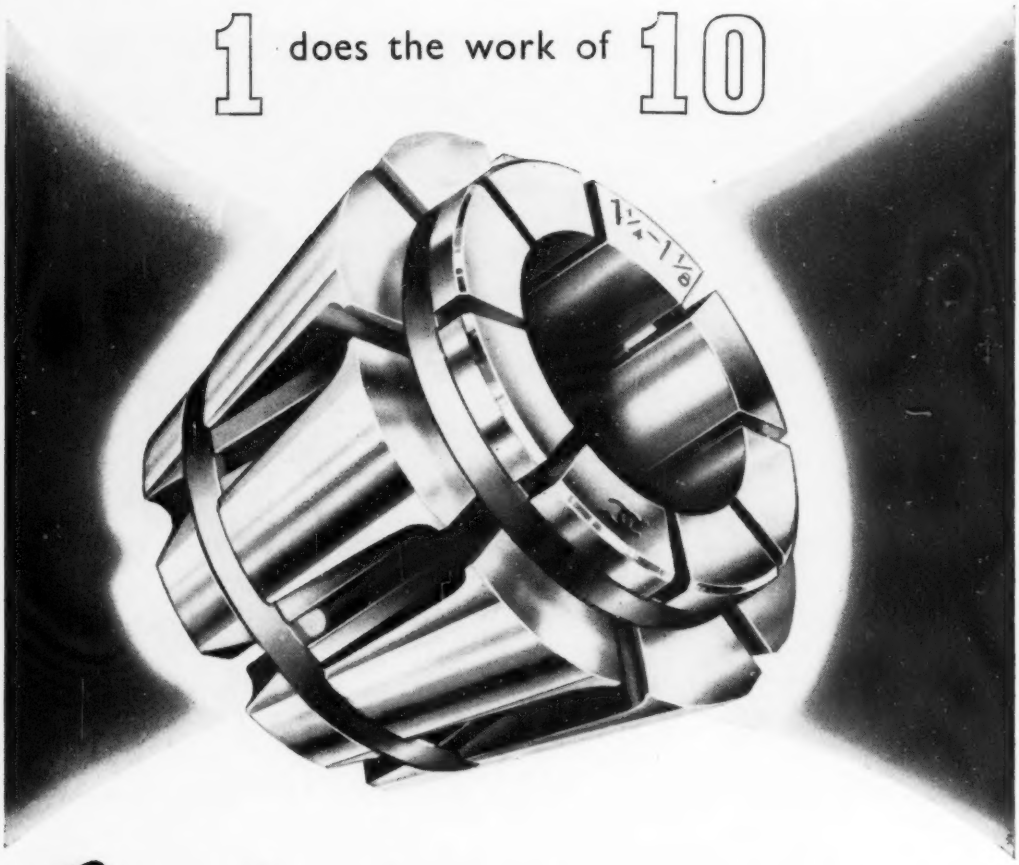

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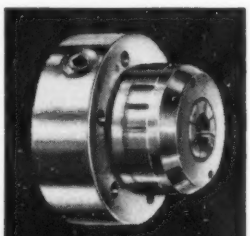

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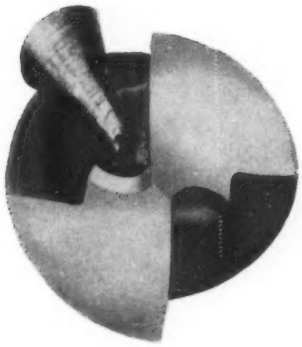

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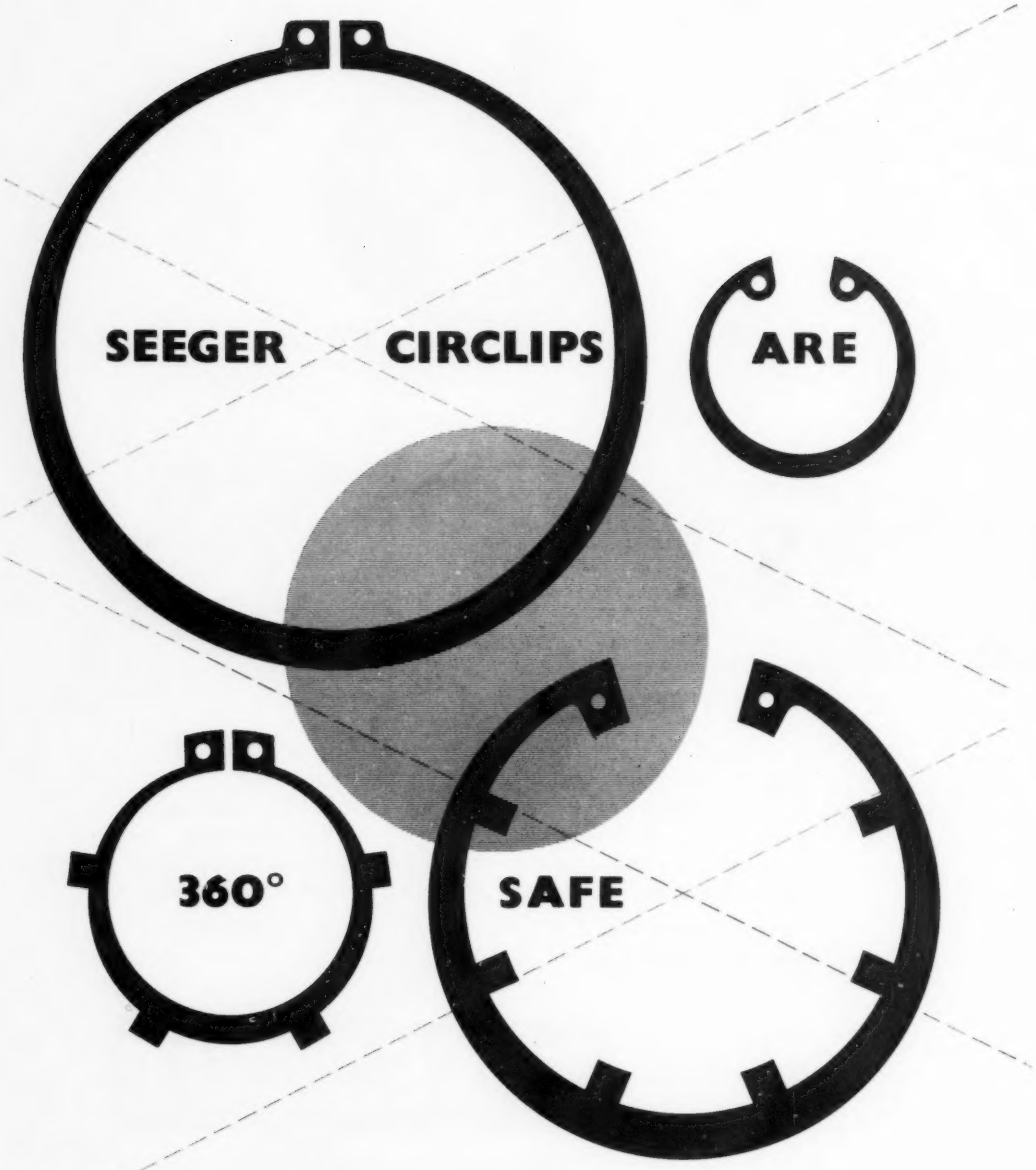

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Stock removal:
0.004" to 0.005"

Grinding Time:
75 seconds

Surface finish:
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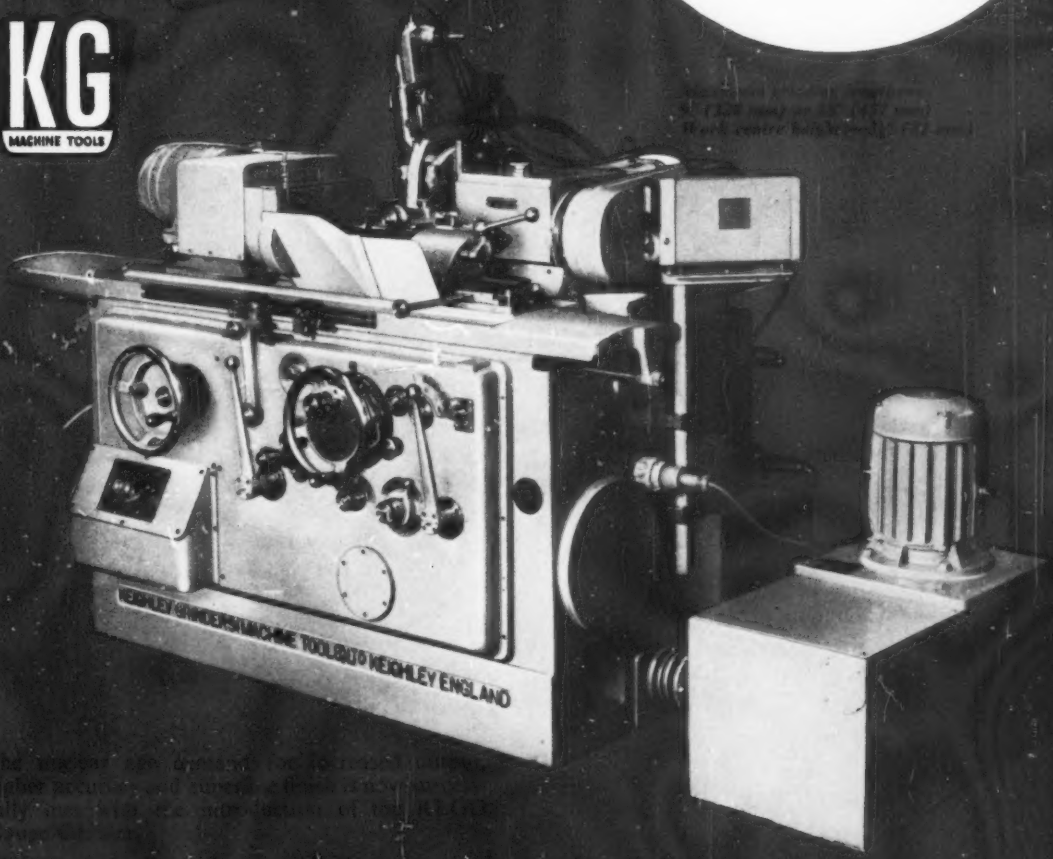
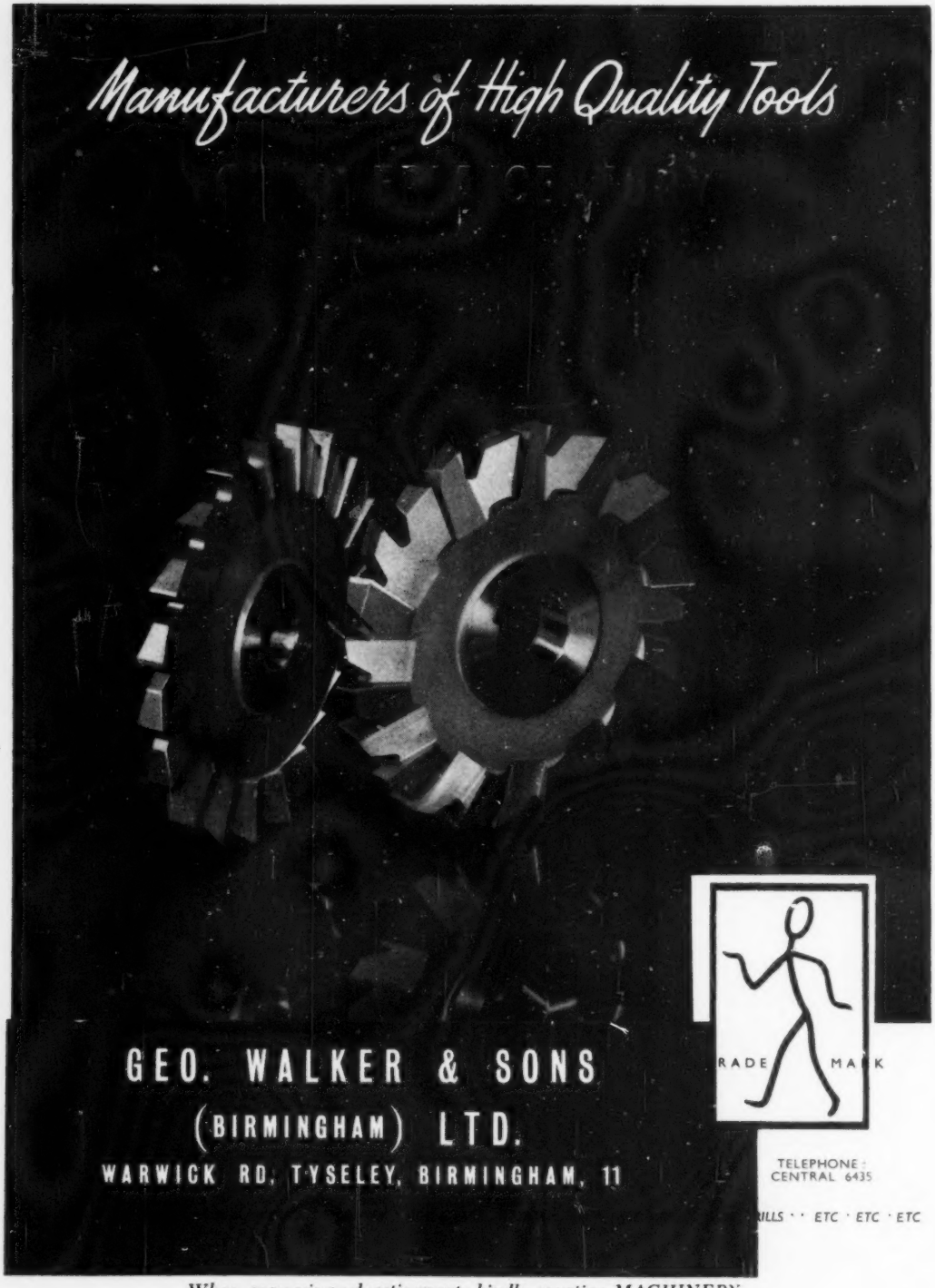
KG
MACHINE TOOLS





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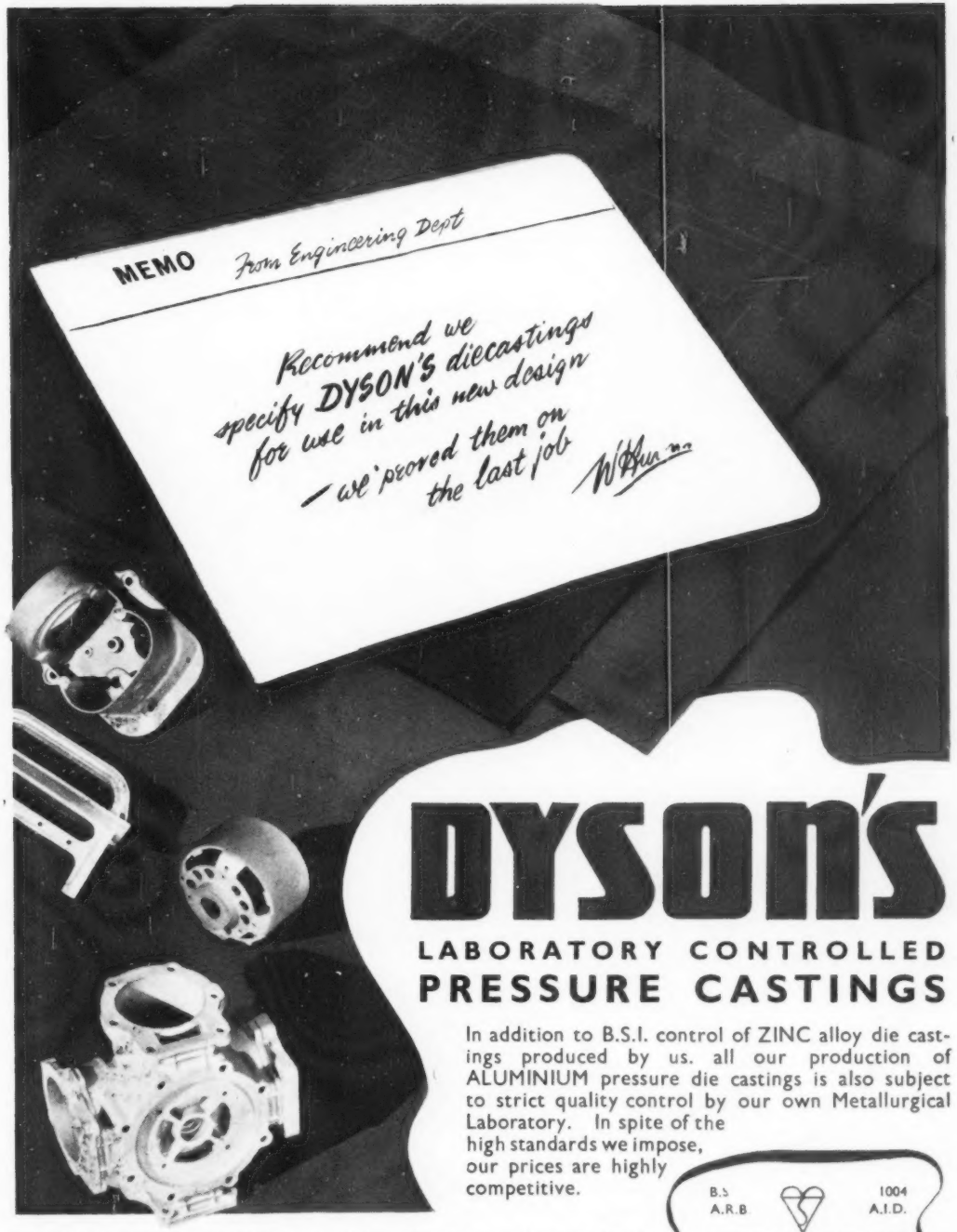
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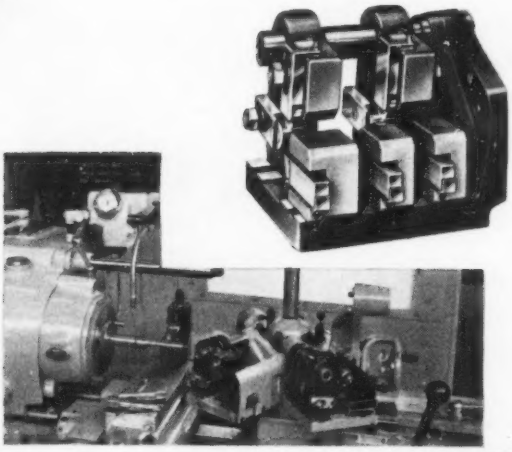

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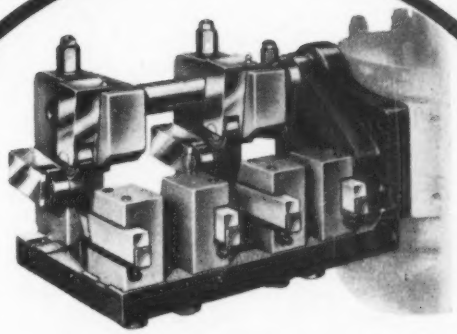

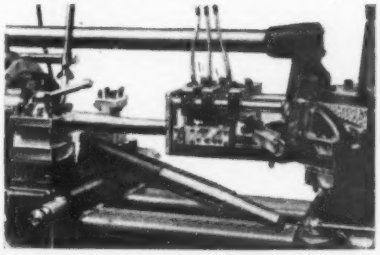

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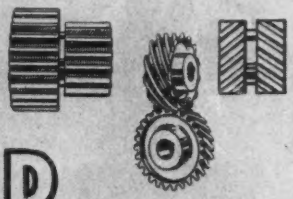

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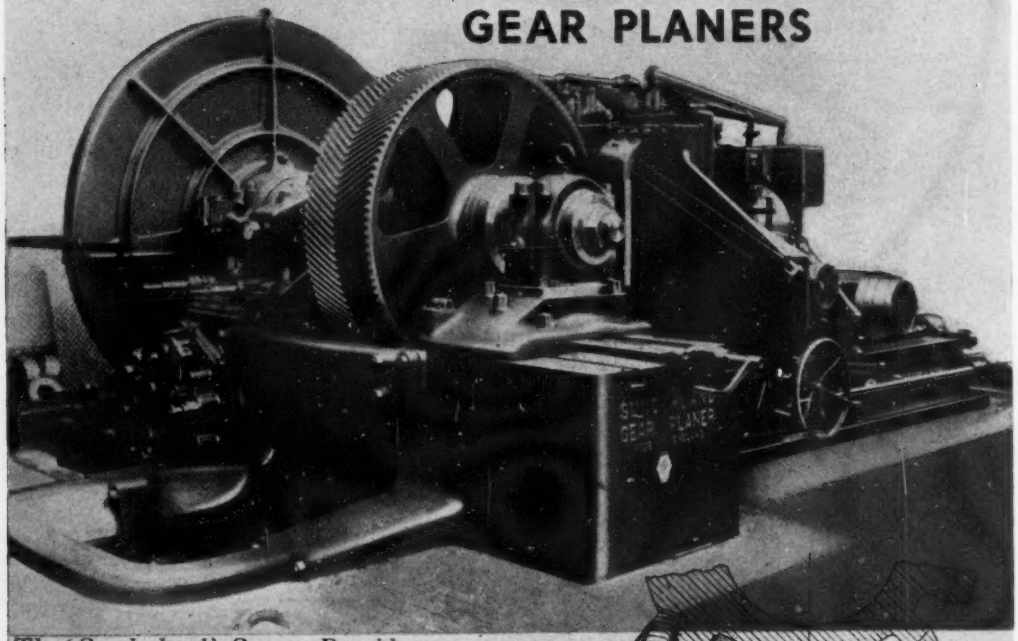

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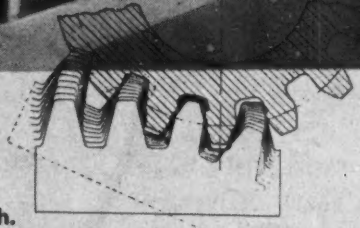

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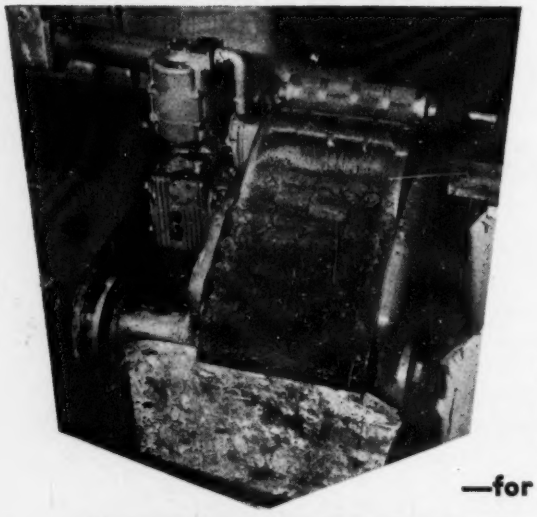

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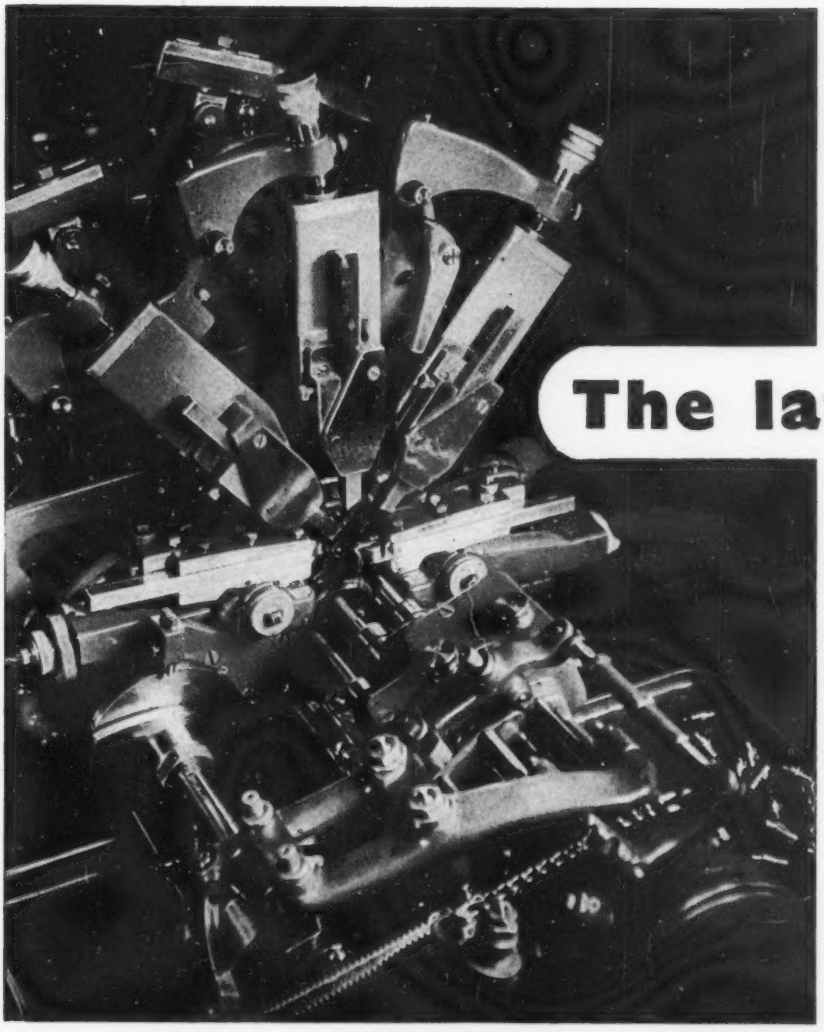

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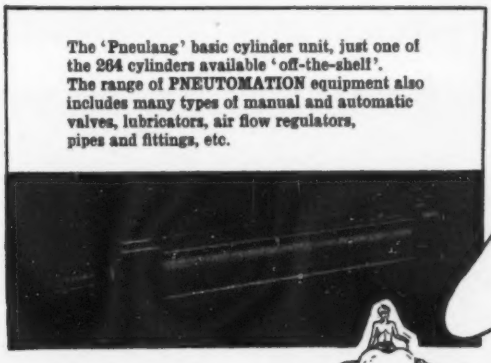

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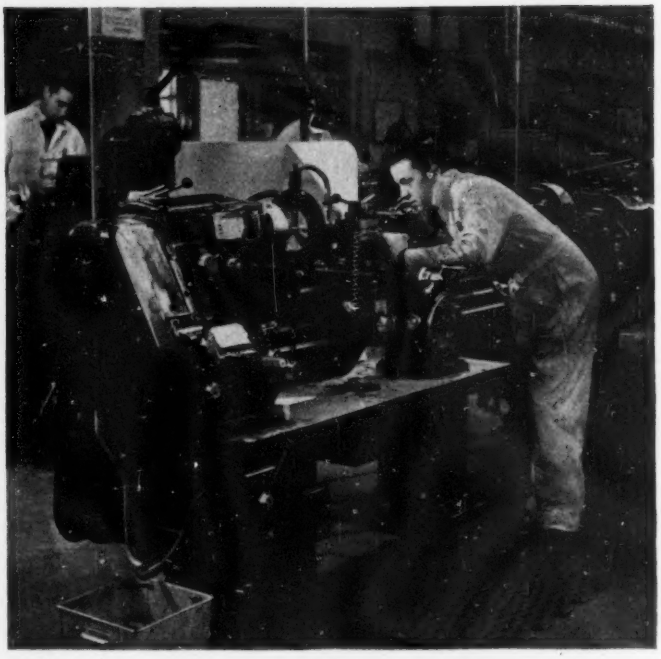

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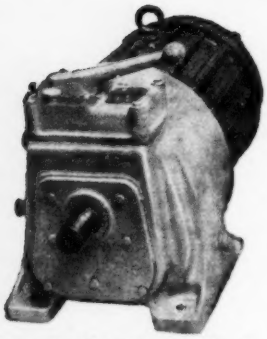

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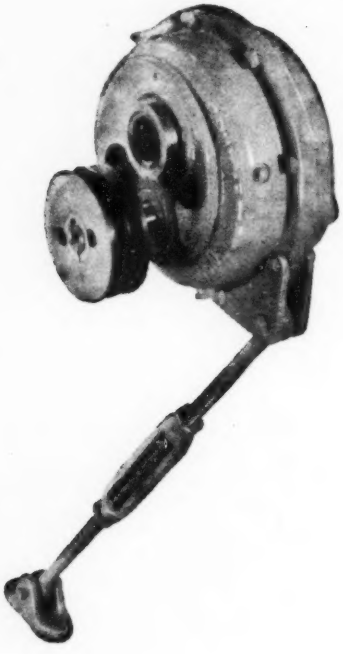

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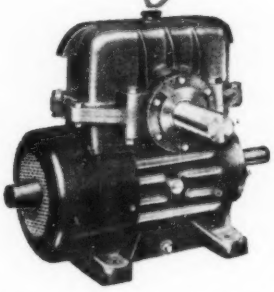

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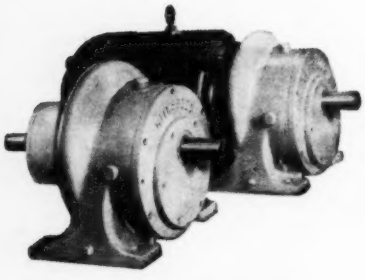

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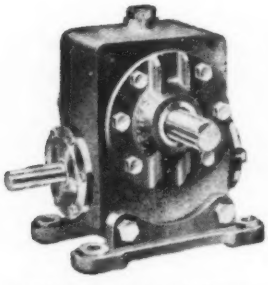

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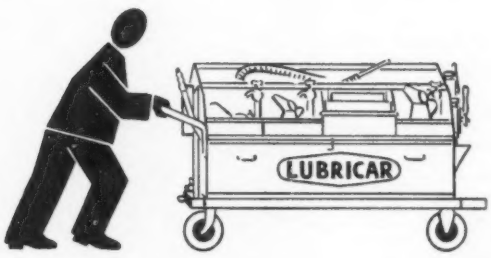

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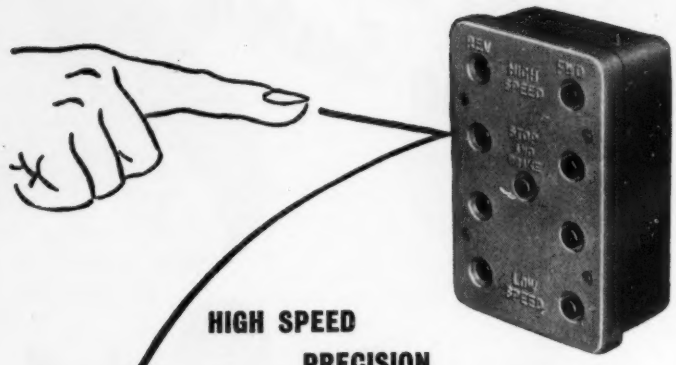

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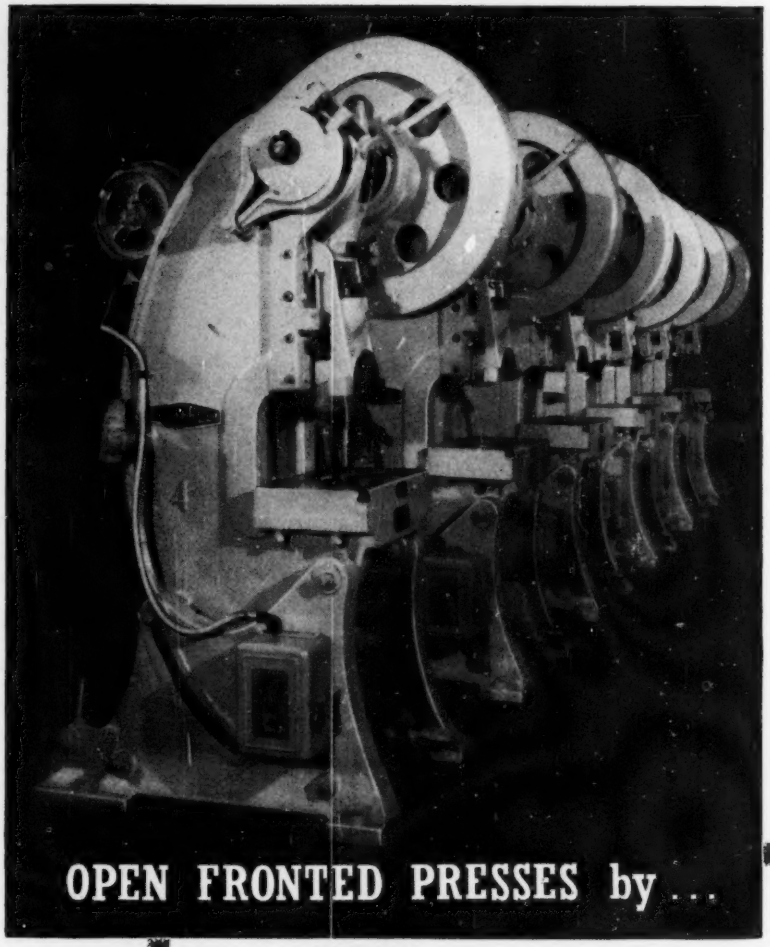

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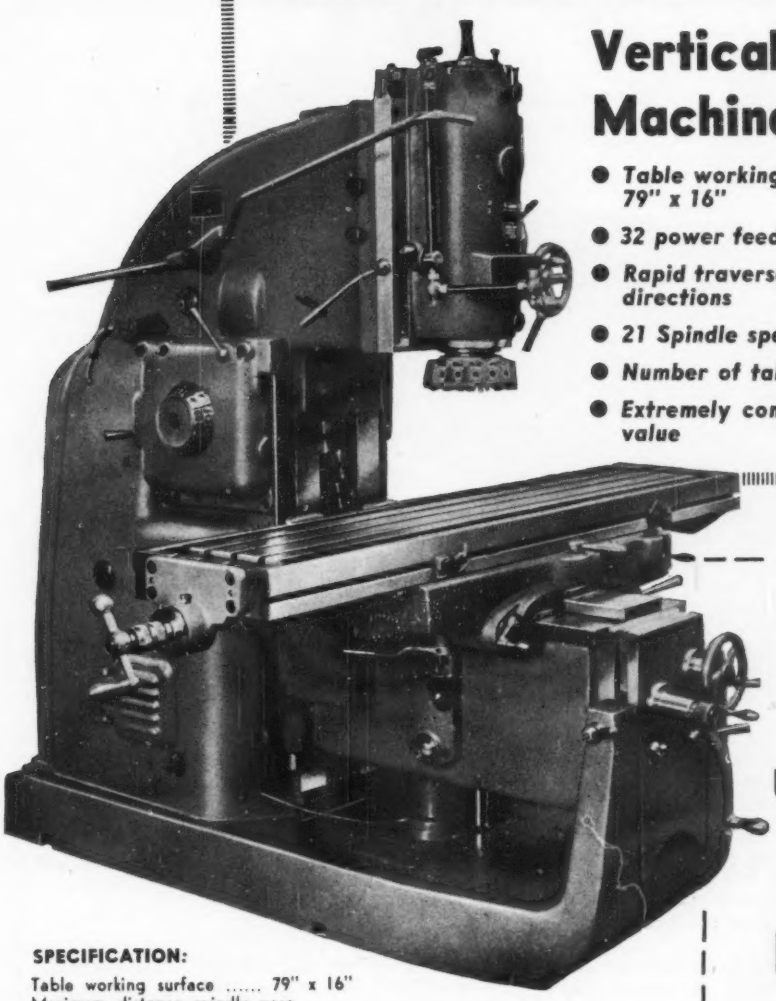

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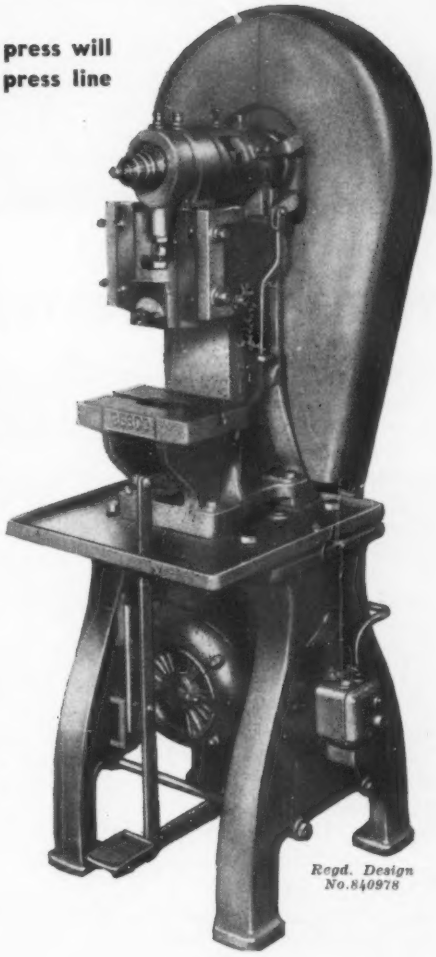

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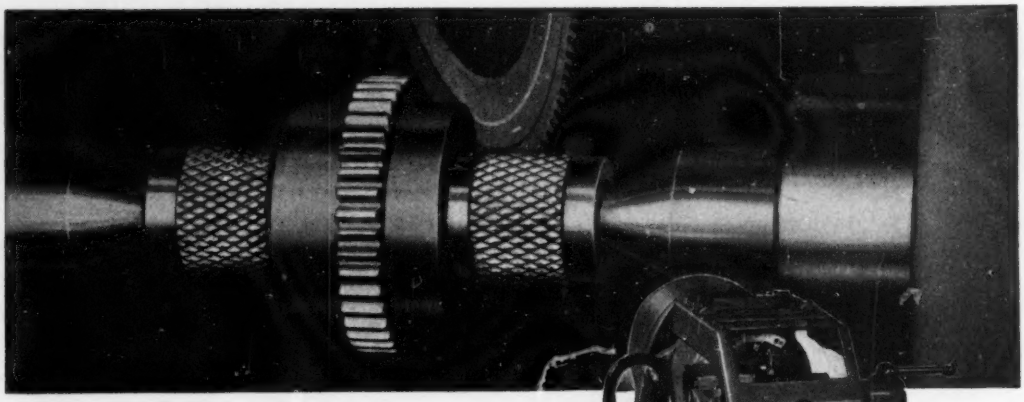

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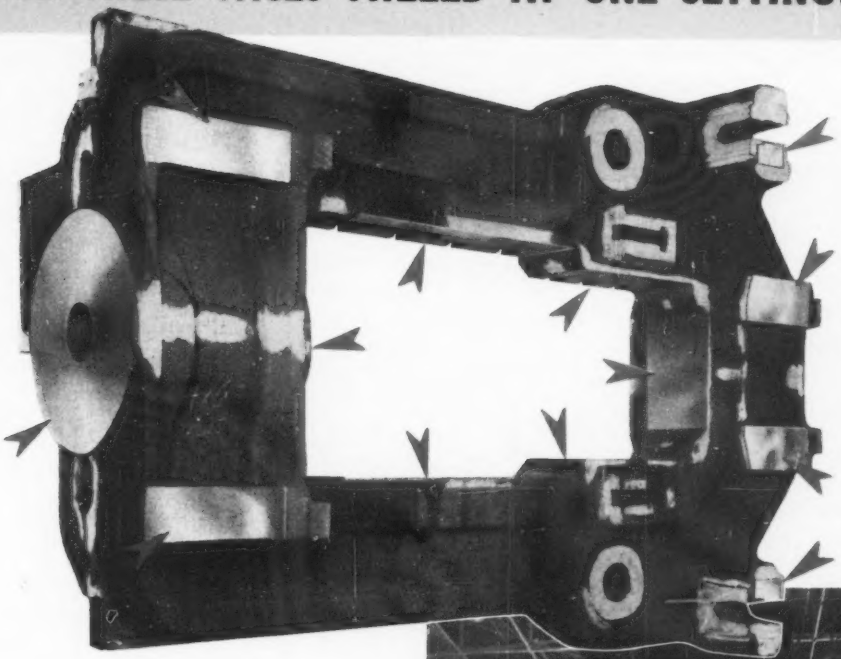
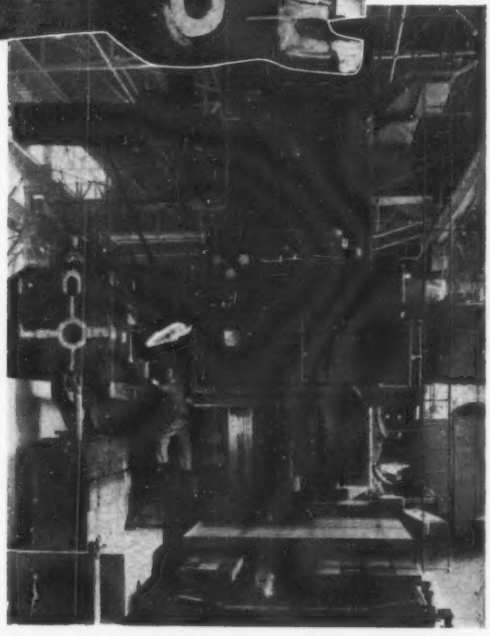


on this ASQUITH *machine*



The illustration above shows a mill housing which has been machined on the end, front and window faces at one setting on the Asquith 7in. spindle Ram Type Horizontal Milling and Boring Machine. Exceptional rigidity and accuracy for heavy duty cutting or match milling is ensured by the 16in. diameter driving flange of the milling sleeve, fully supported by the large section ram. The machine can be operated from the pendant and many new design features such as steering control, for milling surfaces of irregular outline or large circumference, are incorporated whereby this Asquith machine may be regarded as the most up-to-date machine of its type for heavy engineering work.

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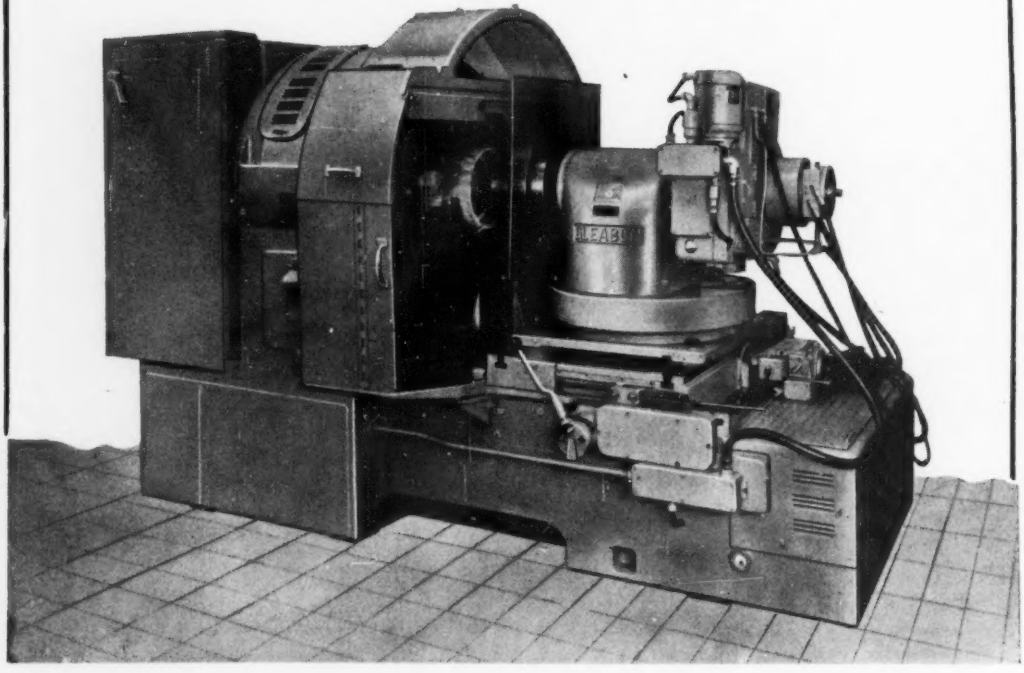

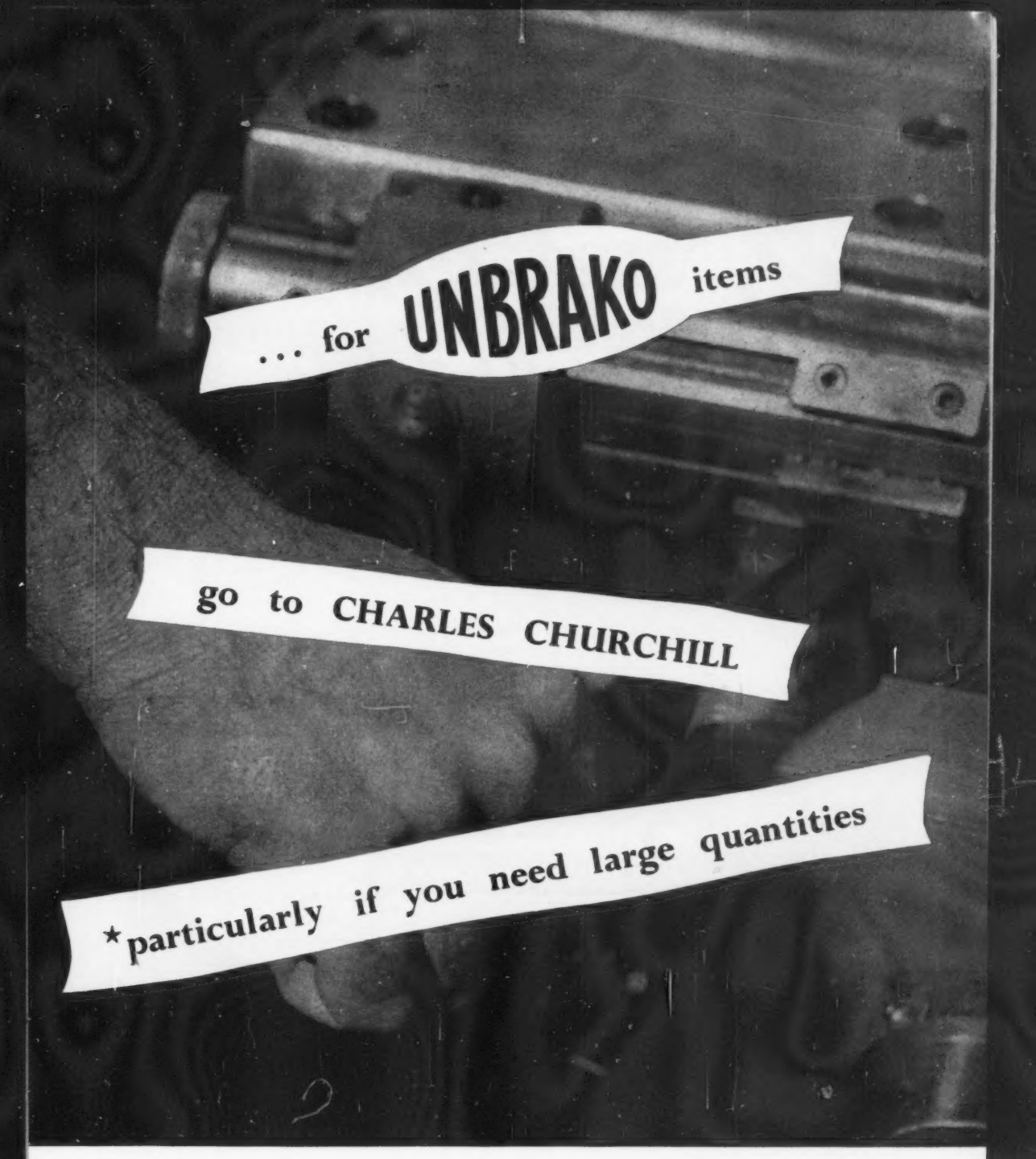

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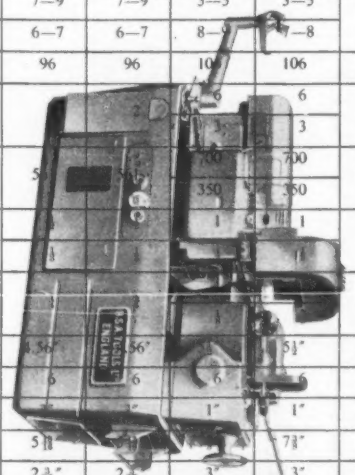
MACHINE		48	68	18L	25L	68L	88L	98L	138L	168L	METRIC 24	METRIC 36	METRIC 52
Workspindle capacity	round	½"	¾"	18 mm.	25 mm.	¾"	1"	1¼"	1⅝"	2"	24 mm.	36 mm.	52 mm.
	square	.353"	½"	13 mm.	18 mm.	.0530"	.0708"	1⅛"	1¼"	1.414"	17 mm.	25.4 mm.	35 mm.
	hexagon	.437"	⅝"	16 mm.	22 mm.	0.650"	0.866"	1⅜"	1⅝"	1.730"	20 mm.	30 mm.	45 mm.
Max feed in one movement	long stroke	2"	3"	75 mm.	75 mm.	3"	3"	4"	4"	4"	90 mm.	90 mm.	90 mm.
	short stroke	1"	2"			2"		2½"	2½"				
Stroke of turret cam (standard)		1⅜"	2¼"	50 mm.	50 mm.	2¼"	2¼	3"	3"	3"	80 mm.	80 mm.	80 mm.
Max. diameter using diehead		⅜" fine	½" fine	16 mm.	16 mm.	⅜" fine	⅜" fine	1"	1¼"	1¼"	18 mm.	18 mm.	18 mm.
Range of spindle speeds		166—7,370	53—4,480	40—4,500	40—4,500	53—4,480	53—4,480	70—3490 24—3590	78—2300 25—2540	69—1,520	38—3,000	24—1,900	30—1,500
Number of high speeds	4 speed	18	10	14	14	10	10	22	19	17	10	10	8
	2 speed			14	14	10	10	13	12				
Low speeds available for each high speed		2	10	11—13 9—10	11—13 9—10	7—9 6—7	7—9 6—7	3—5 8—9	3—5 7—8	3—5	4—5	4—5	4—5
Number of cycle times		46	65	96	96	96	96	10	106	106	46	46	46
Cycle time range (secs) fastest	long stroke	¼	2	2	2			6	6	6	8	8	8
	short stroke	¼						3	3				
slowest	long stroke	75	180	561	561			700	700	700	360	360	360
	short stroke	56¼						350	350				
Actual time to feed stock (secs)	long stroke	⅓	½	½	½			1	1	1	1	1	1
	short stroke	⅓	½					½	½				
Time to change speed (secs)	long stroke	½	½	½	½			½	½	½	½	½	½
	short stroke	½	½					½	½				
Diameter of turret		3⅜"	4 1/16"	116 mm.	116 mm.	4.56"	4.56"	5"	5½"	5½"	140 mm.	140 mm.	140 mm.
Number of turret holes		6	6	6	6	6	6	6	6	6	6	6	6
Diameter of turret holes		⅜"	½"	19.05 mm.	19.05 mm.	½"	½"	1"	1"	1"	25.4 mm.	25.4 mm.	25.4 mm.
Distance chuck to turret	max.	3⅜"	5⅛"	120 mm.	120 mm.	5 1/16"	5 1/16"	7⅛"	7⅛"	7⅛"	180 mm.	180 mm.	180 mm.
	min.	1 1/16"	2⅛"	49 mm.	49 mm.	2 3/16"	2 1/16"	3"	3"	3"	64 mm.	64 mm.	64 mm.
Turret slide adjustment		1/16"	⅛"	21 mm.	21 mm.	1 5/16"	1 5/16"	1¼"	1¼"	1¼"	38.1 mm.	38.1 mm.	38.1 mm.
Spindle centre to top of cross slide		1"	1 1/16"	30 mm.	30 mm.	1 1/16"	1 1/16"	1 1/16"	1 1/16"	1 1/16"	36 mm.	36 mm.	36 mm.
Movement of cross slide		1"	1¼"	32 mm.	32 mm.	1¼"	1¼"	1⅜"	1⅜"	1⅜"	40 mm.	40 mm.	40 mm.



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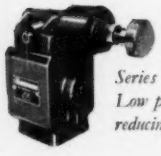

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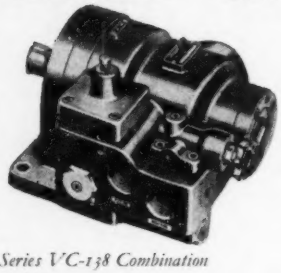
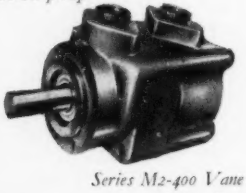
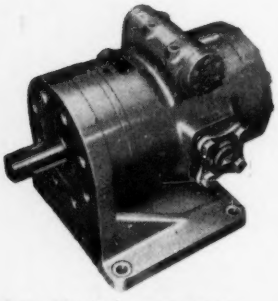
Series URG1 Hydraulic unloading relief valve.



Series VC-138 Combination double pump.



Series M2-400 Vane type hydraulic motor.



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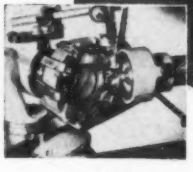
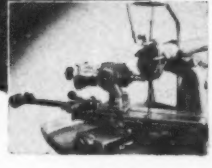


Face Mills



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Grinding wheel size; dia./face/hole	11.8" × 1" × 3"	13.8" × 1.57" × 5"	17.7" × 2" × 8"	20" × 3" × 8"

Model 5.U.

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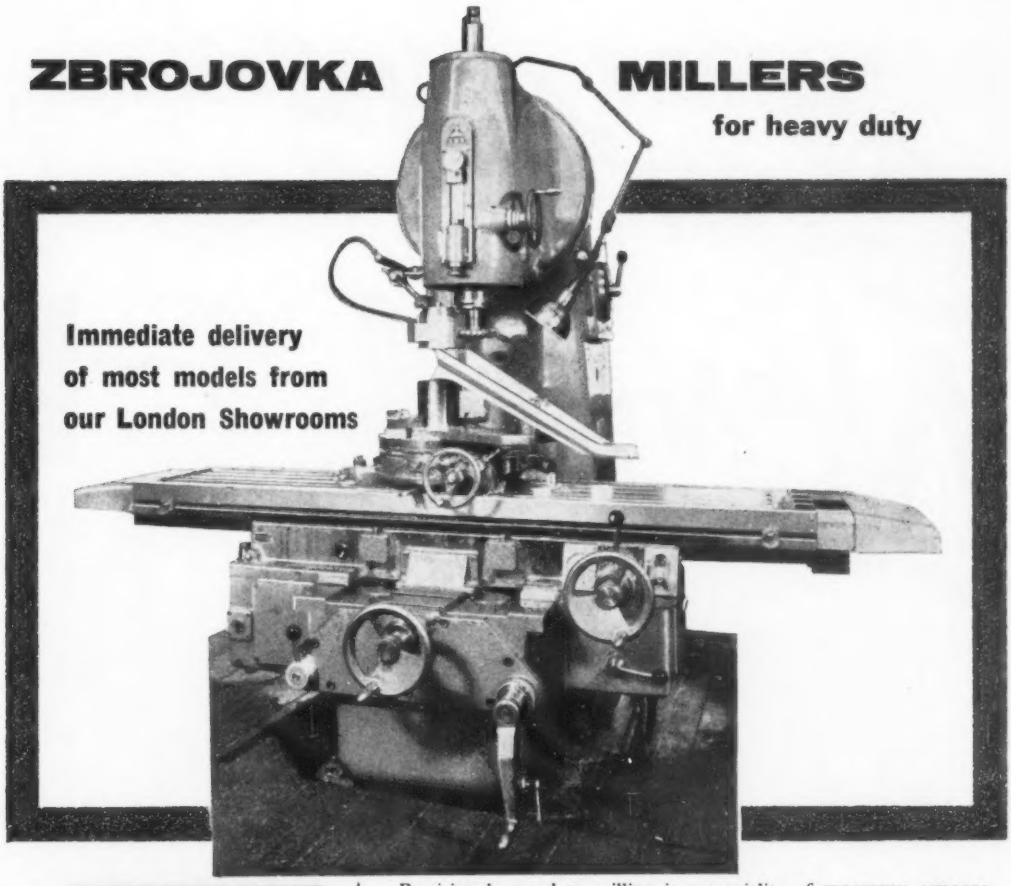
for heavy duty



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Sizes	No. 2	No. 3	No. 4	No. 5
Working surface of table (approx.)	40" x 8"	50" x 10"	64" x 12"	80" x 16"
Power longitudinal travel (approx.)	25"	32"	40"	50"
Power cross travel (approx.)	8"	9"	12"	16"
Spindle speeds	62–2800	45–2000	32–1400	18–1400

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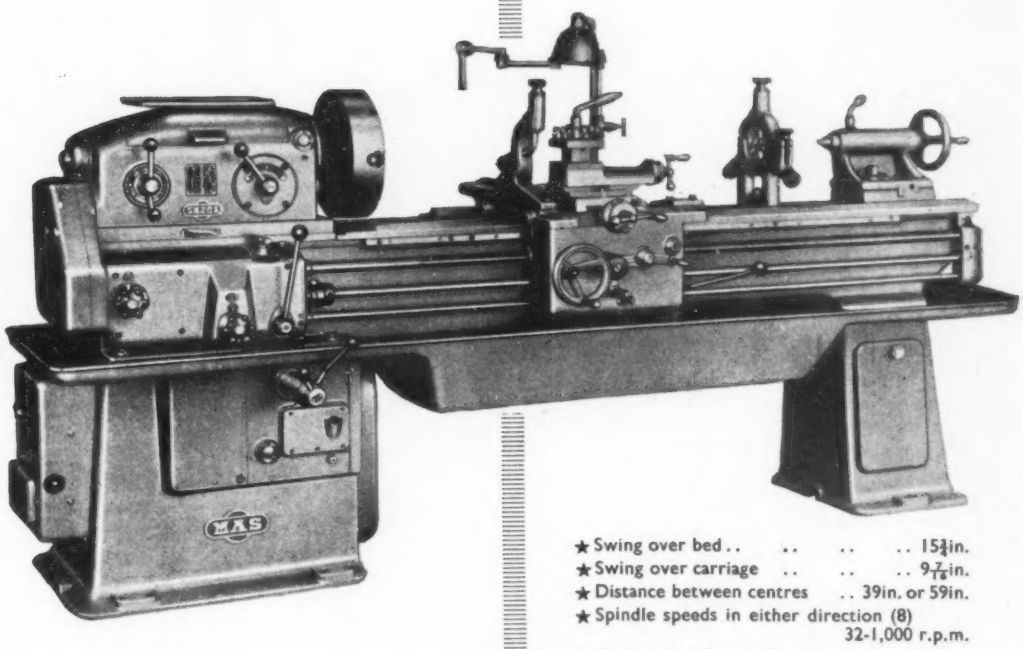

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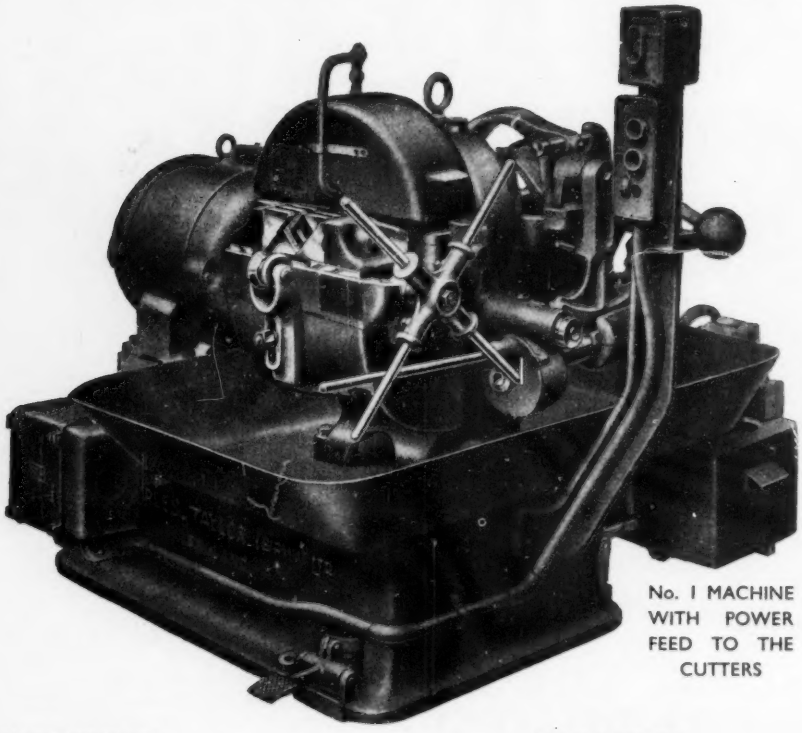

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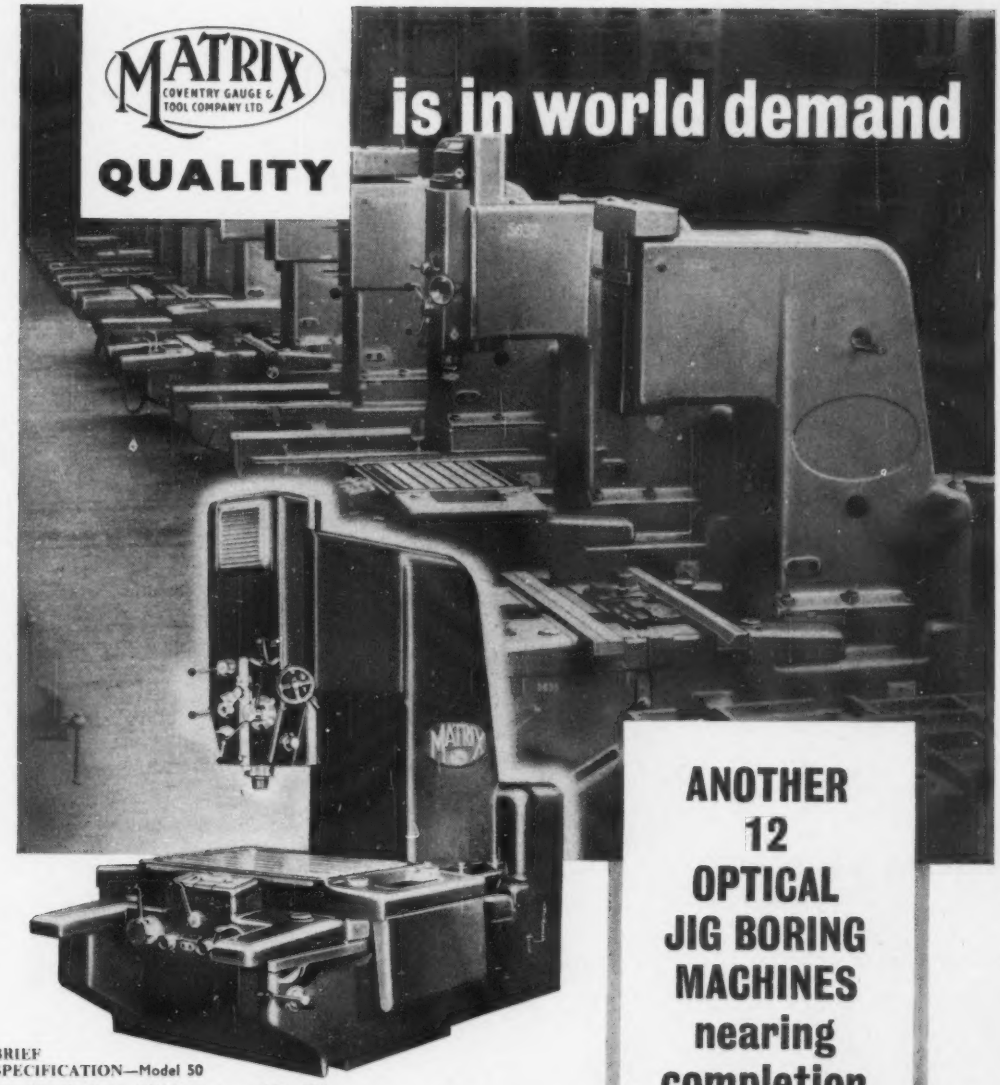

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Longitudinal Travel of Table.....36"
Transversal Travel of Table.....24"
Speeds of Boring Spindle, Stepless—Variable from 40 to 2,000 r.p.m.
Maximum/minimum distance between boring Spindle and top of table 26/2"
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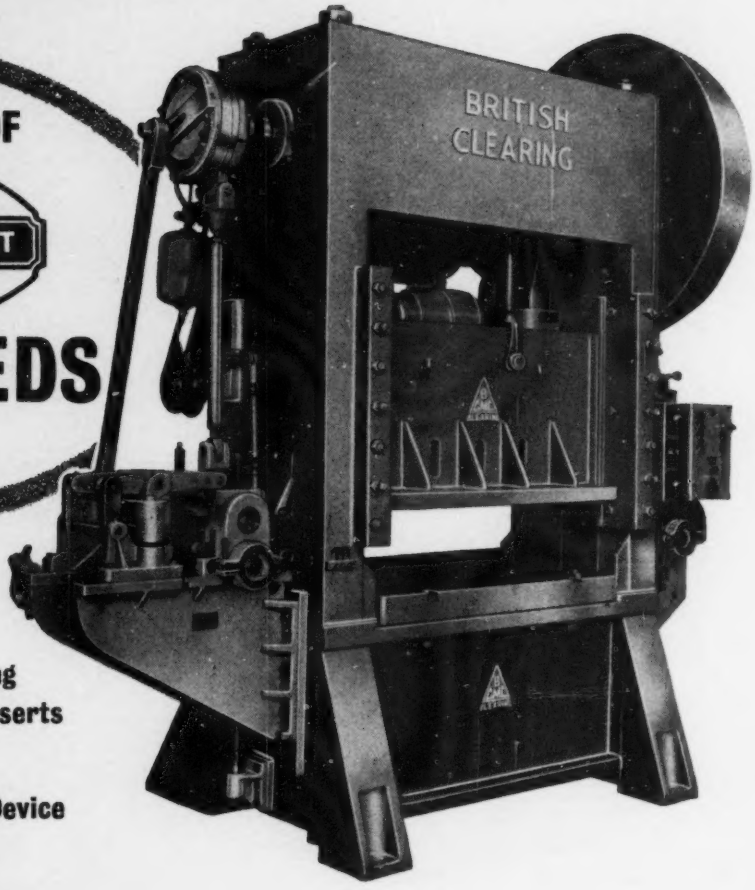

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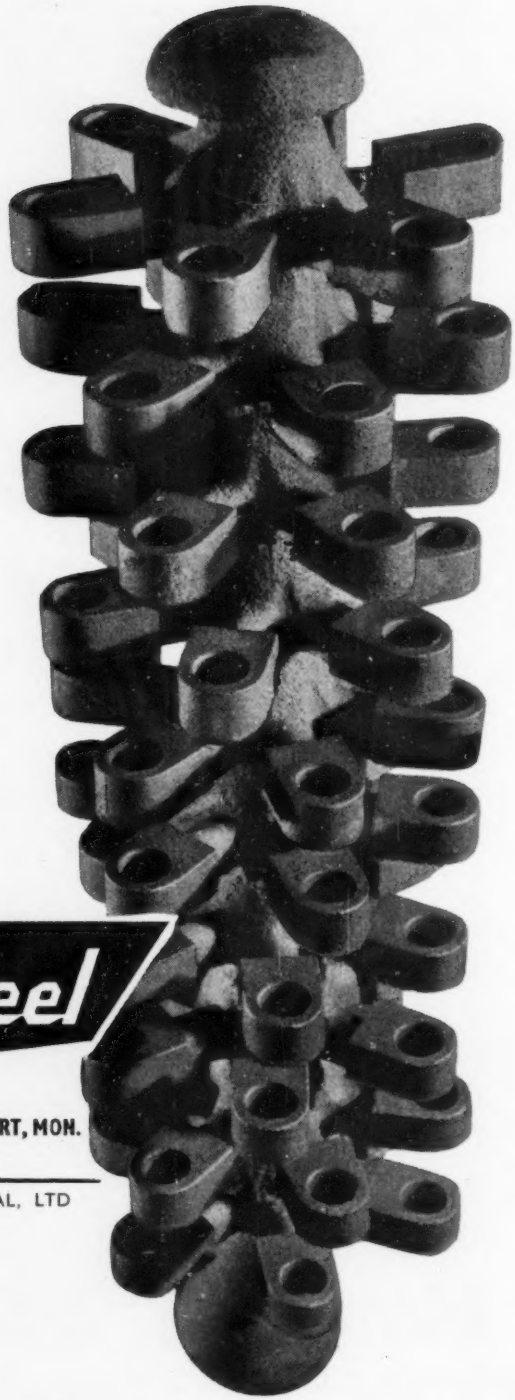

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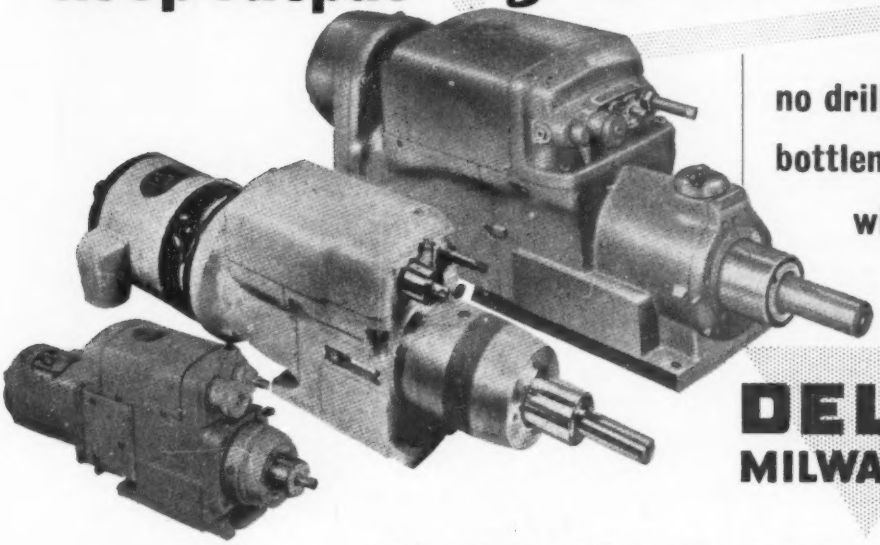

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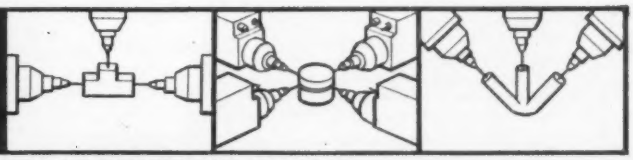

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Accuracy of the gears is ensured by testing, as shown above. Results are given on a graph like the one illustrated. Each vertical division from zero to 20 indicates one-tenth of one-thousandth of an inch, so that the graph in this case proves that the gear has been cut to an overall composite error of three-tenths of one thousandth of an inch. The gear under test was 10 nches dia., 24 D.P. Aluminium Bronze.

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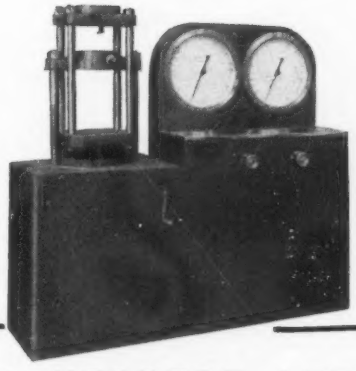

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PROFILROSS COPY MILLING MACHINE

WITH HYDRAULIC TRACER

Can also be used for normal milling work

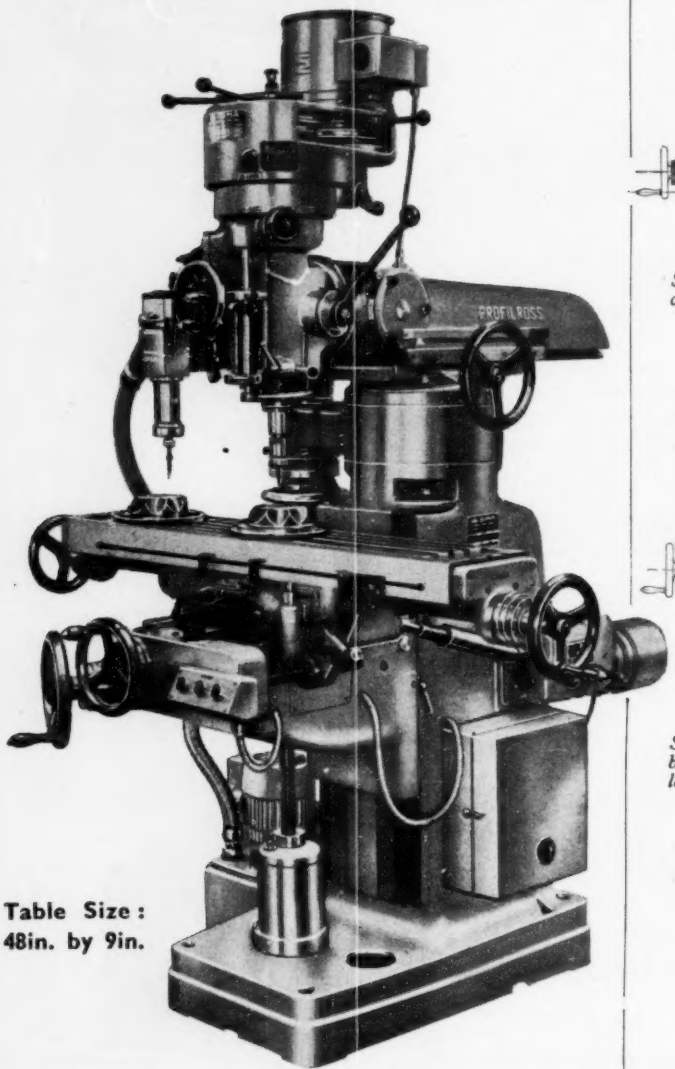
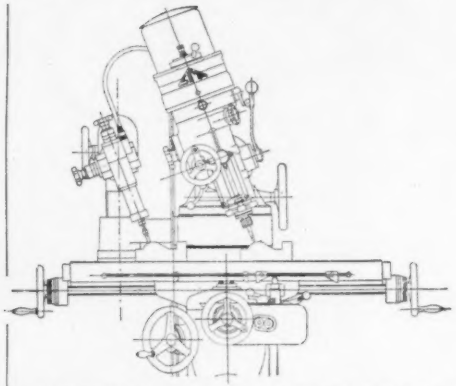
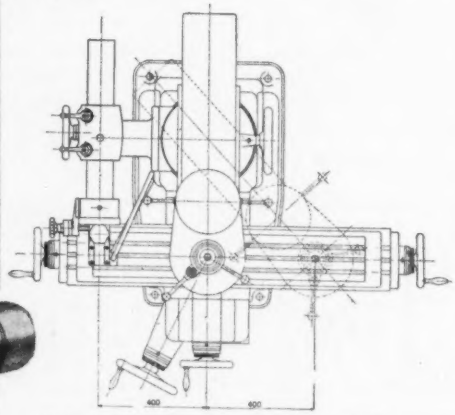


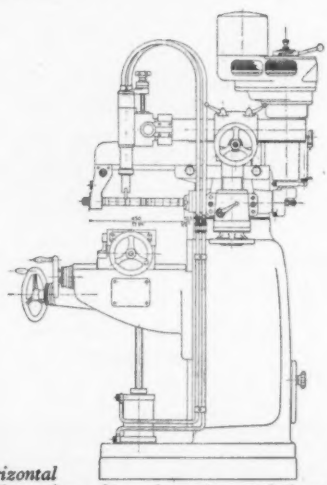
Table Size : 48in. by 9in.



Swivelling Head & Stylus allow 90° angles to be copied.



Swinging overarm allows variation in distance between milling spindle and stylus for copying large pieces.



Horizontal milling unit can be used for rise and fall copying.

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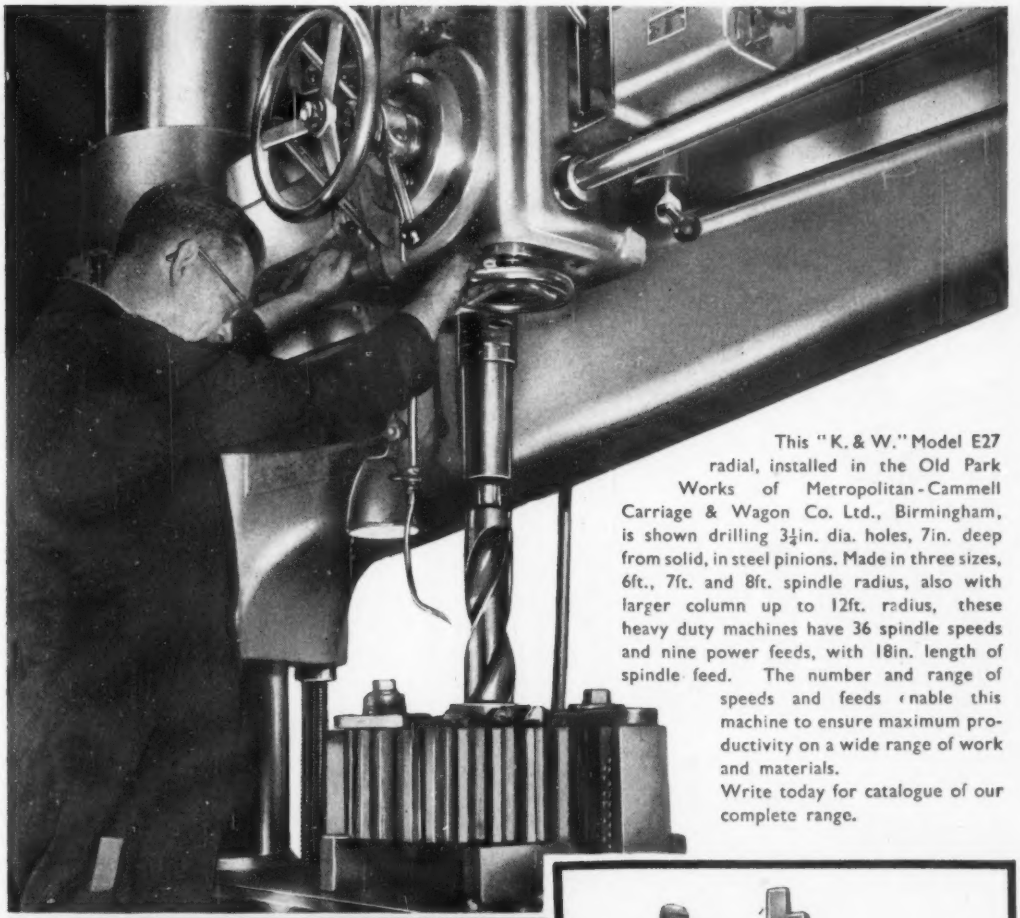

This "K. & W." Model E27 radial, installed in the Old Park Works of Metropolitan-Cammell Carriage & Wagon Co. Ltd., Birmingham, is shown drilling 3¼in. dia. holes, 7in. deep from solid, in steel pinions. Made in three sizes, 6ft., 7ft. and 8ft. spindle radius, also with larger column up to 12ft. radius, these heavy duty machines have 36 spindle speeds and nine power feeds, with 18in. length of spindle feed. The number and range of speeds and feeds enable this machine to ensure maximum productivity on a wide range of work and materials.

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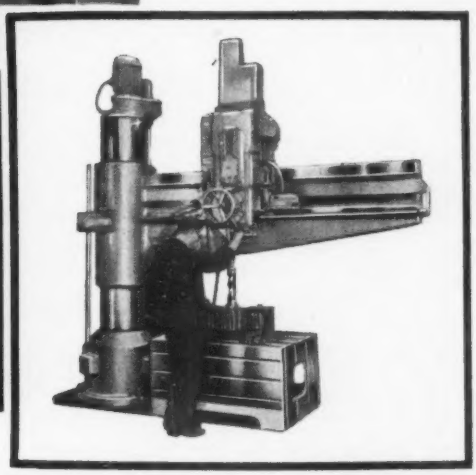

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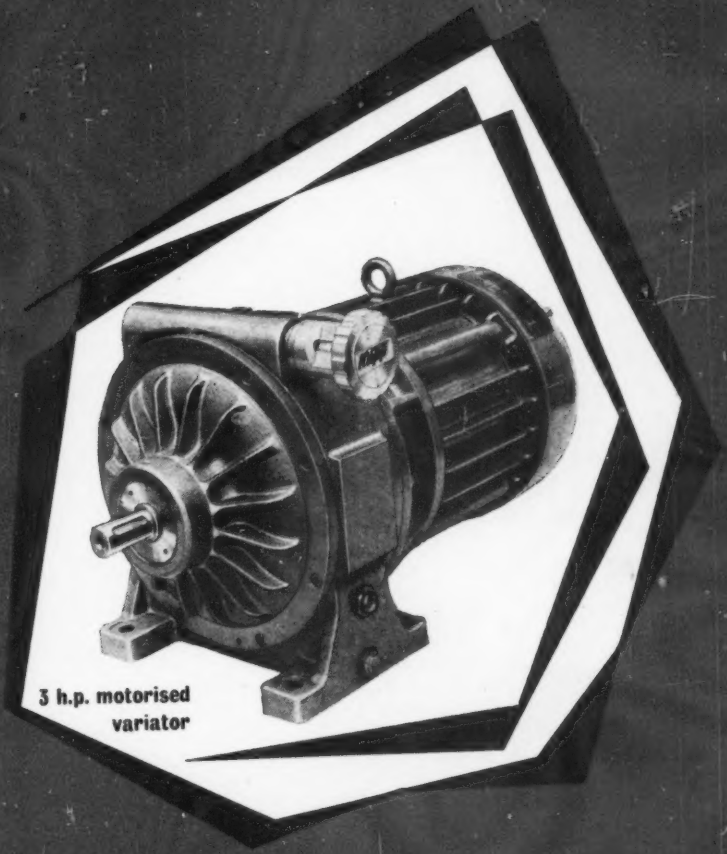

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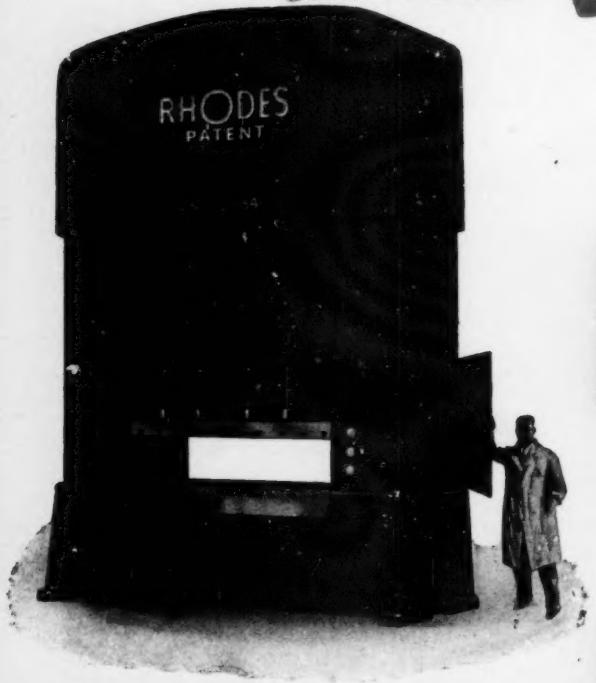

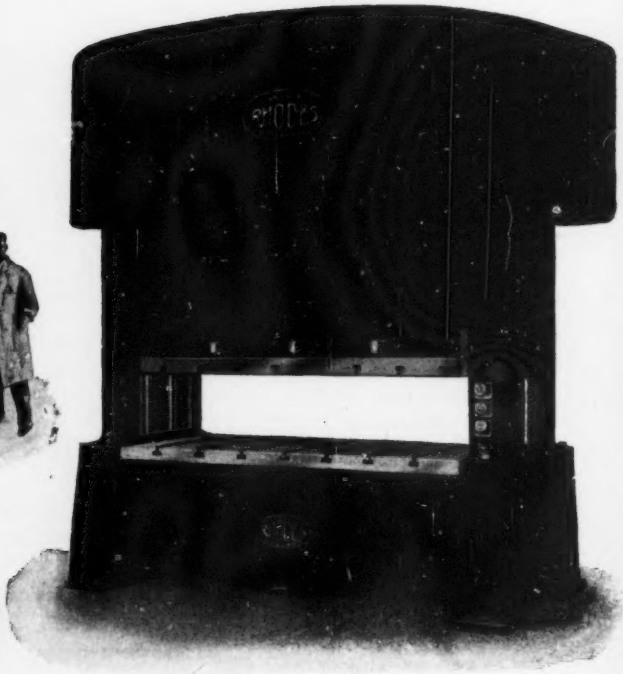

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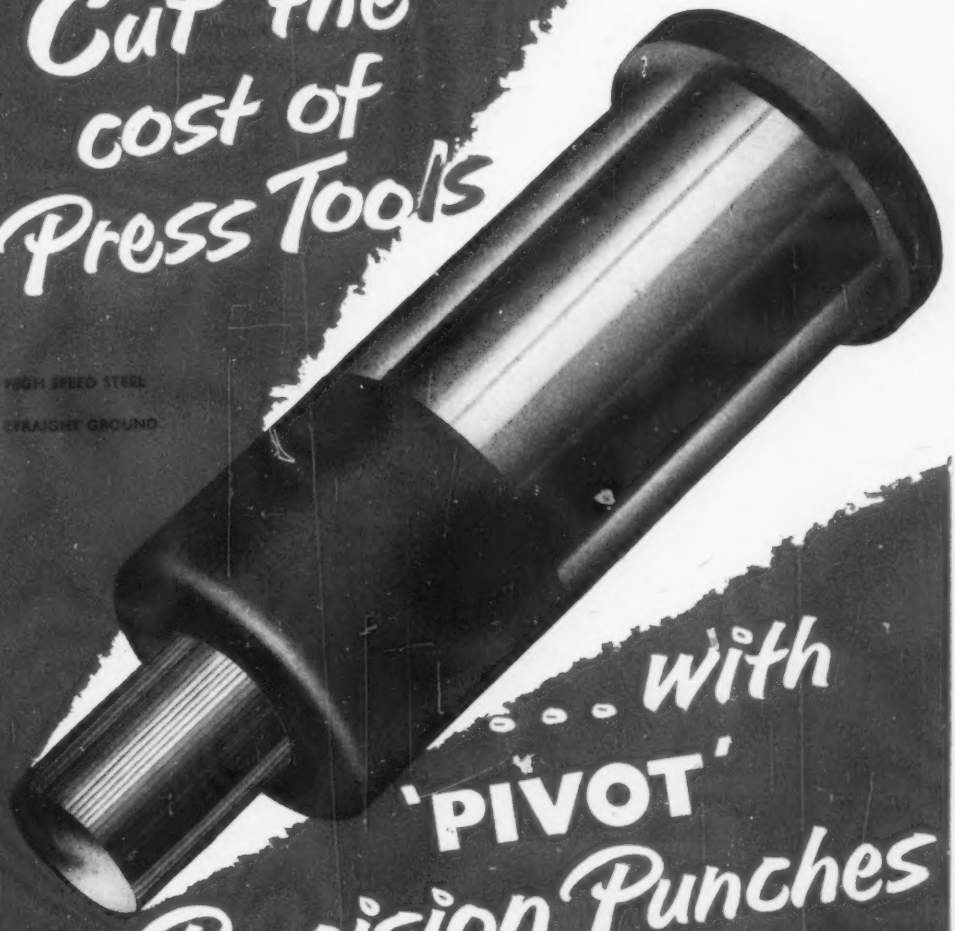

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E2

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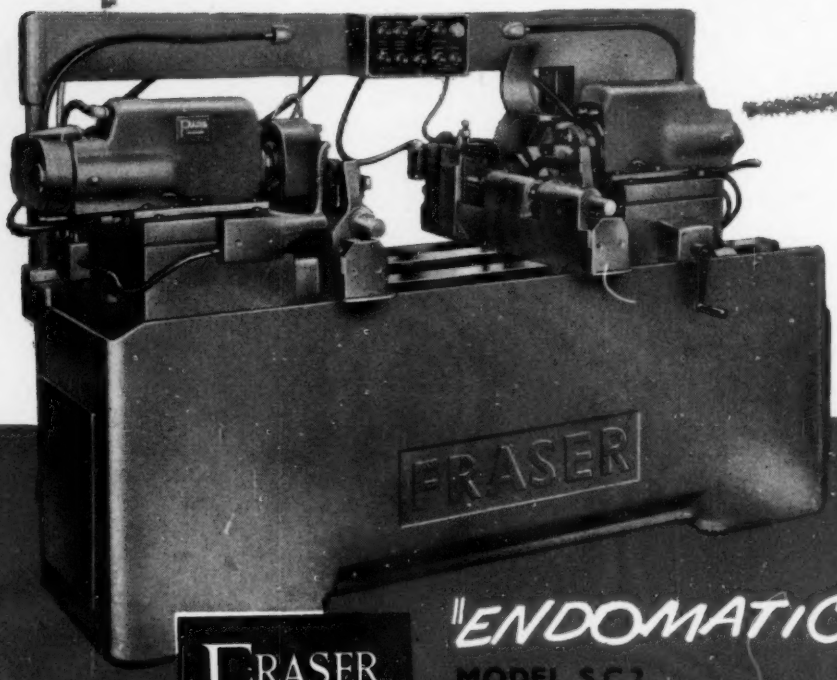

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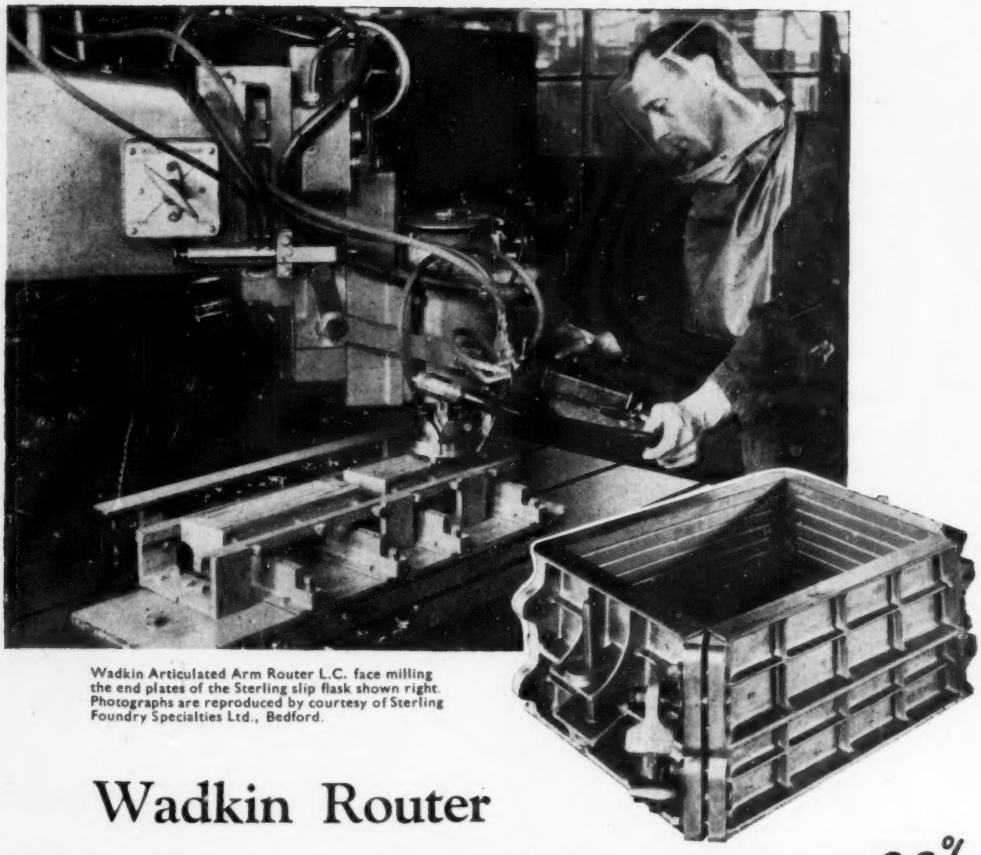

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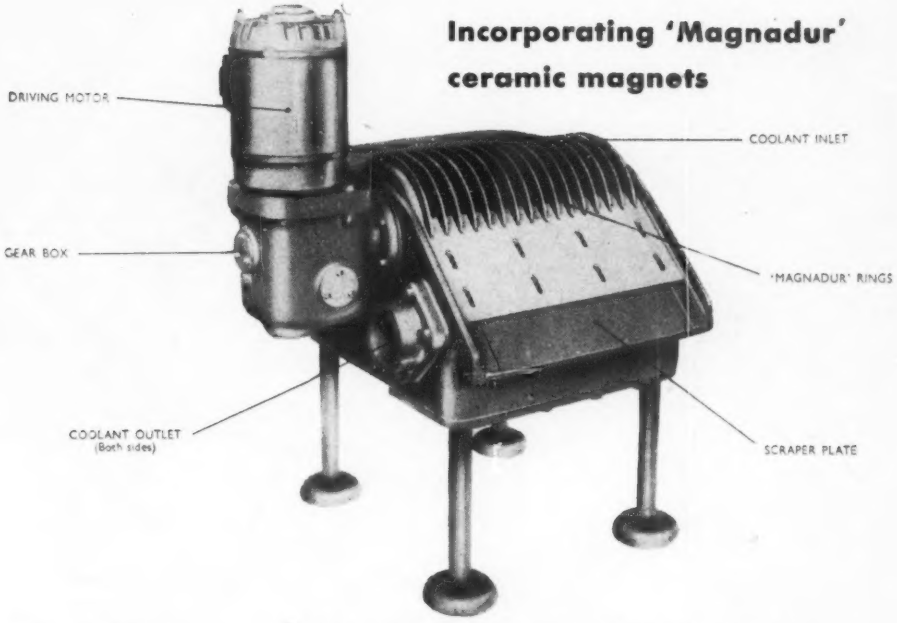

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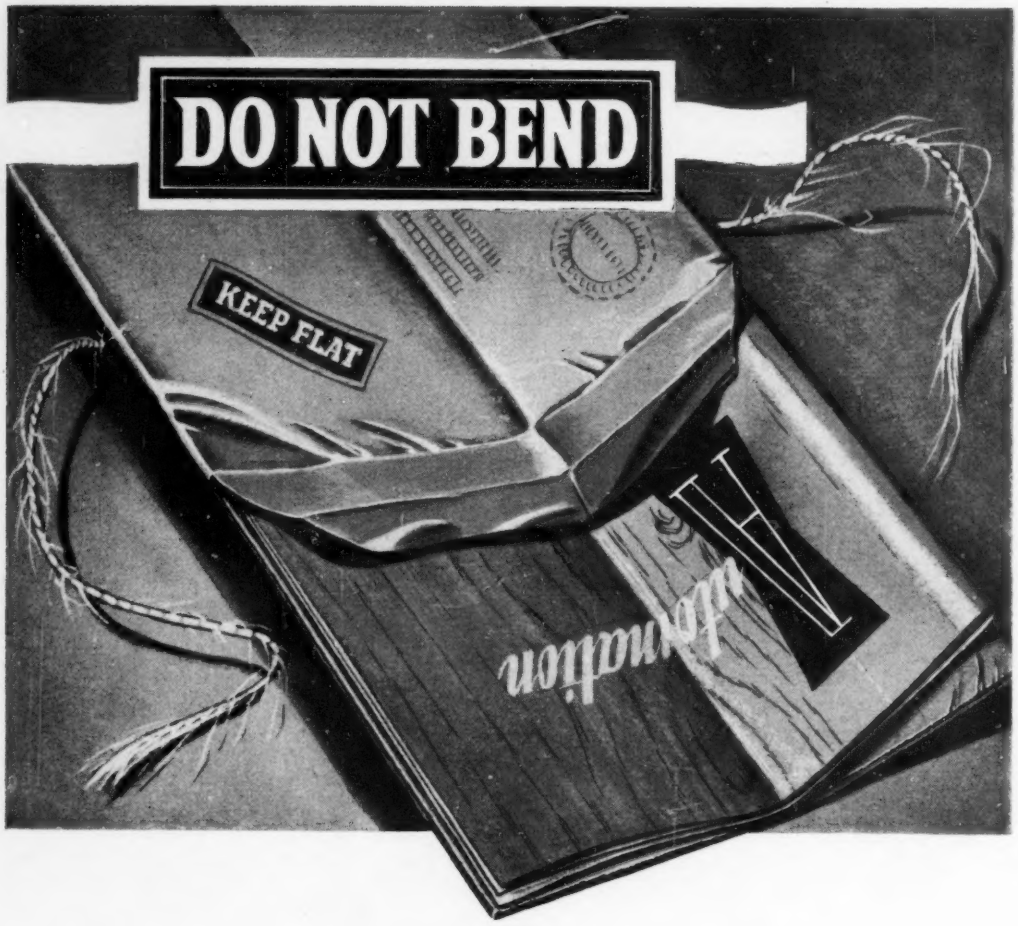

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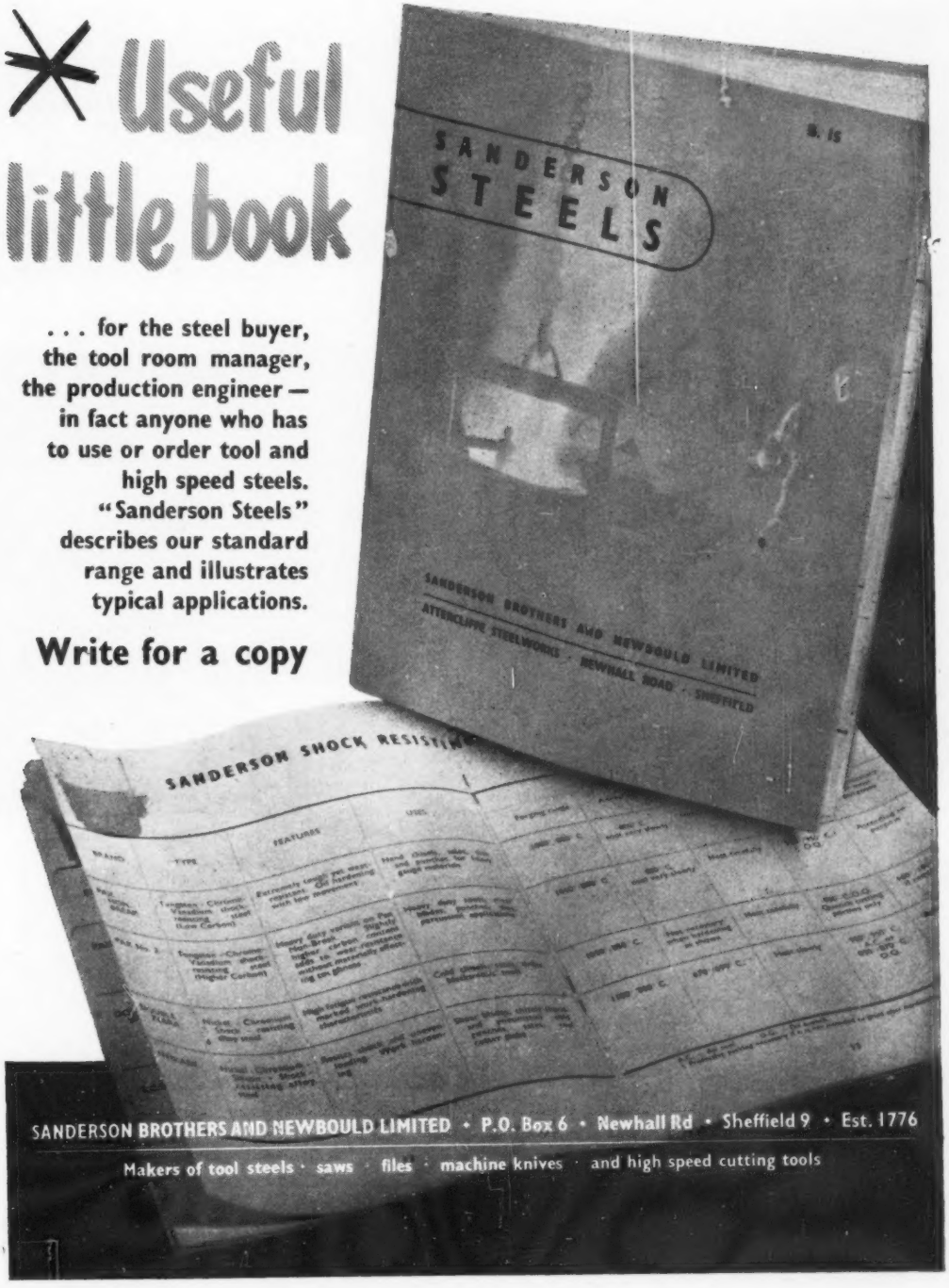
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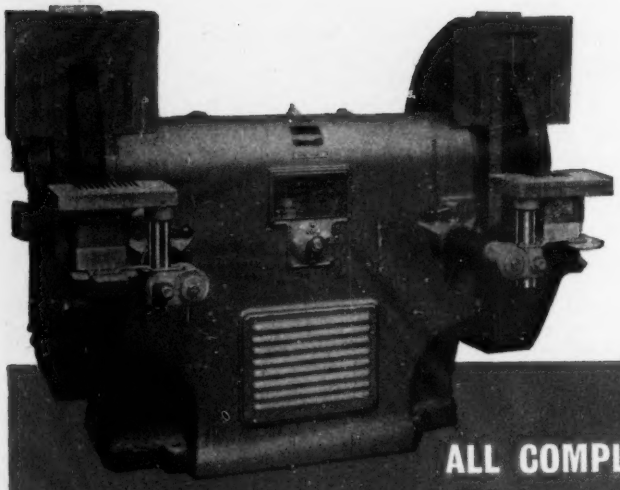

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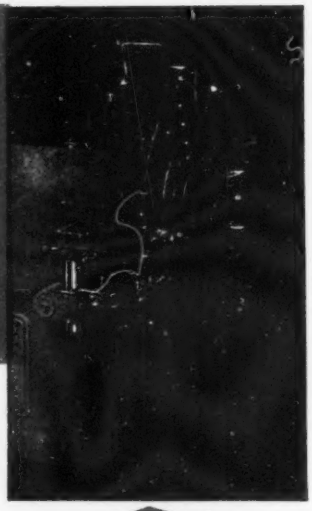

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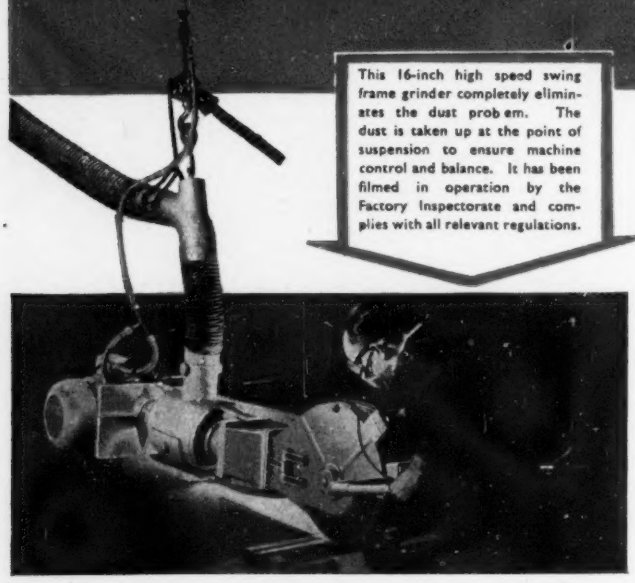

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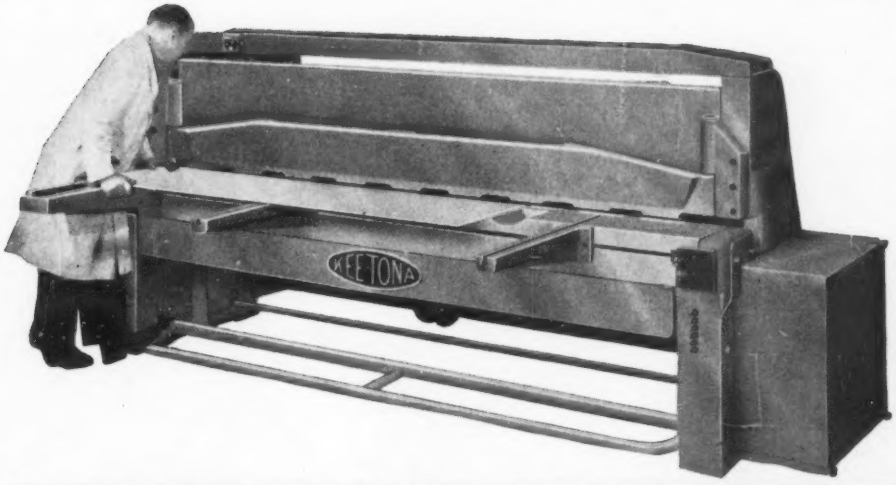

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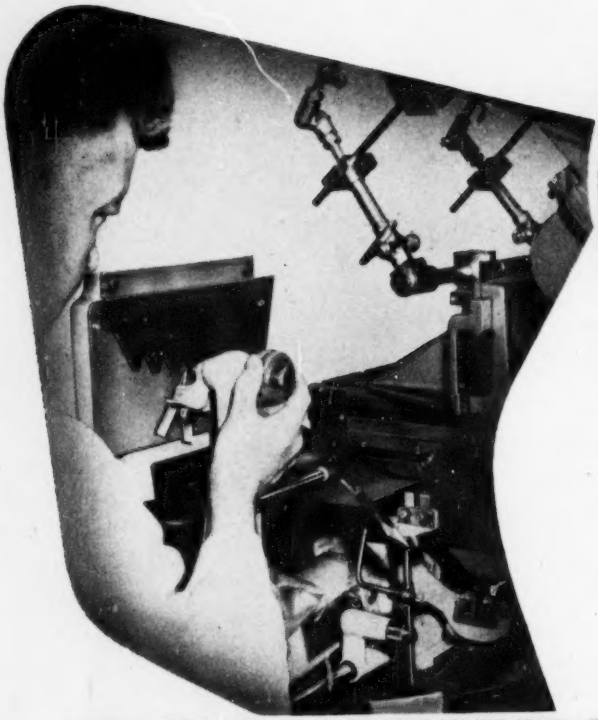

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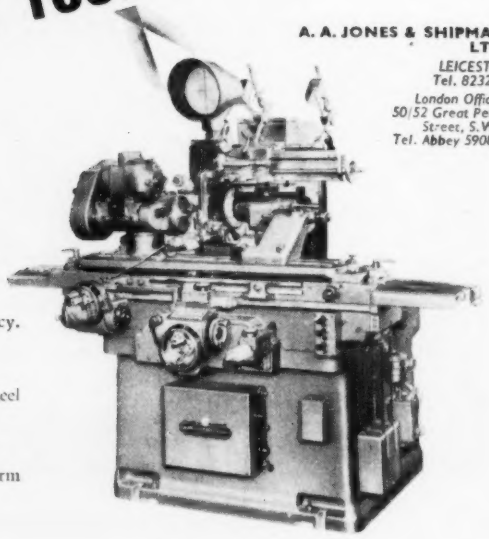

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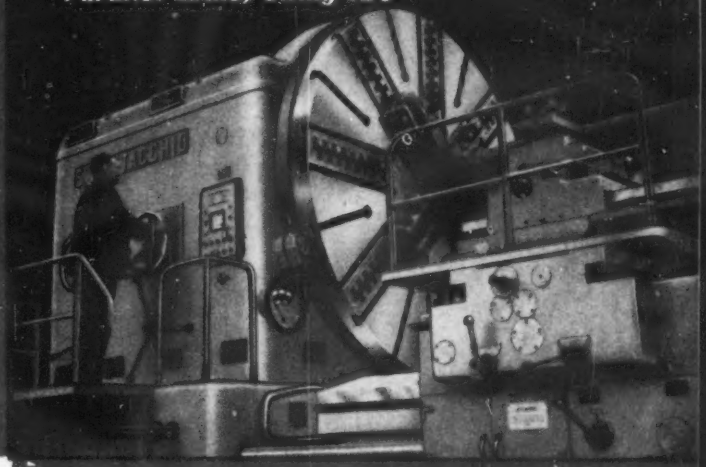

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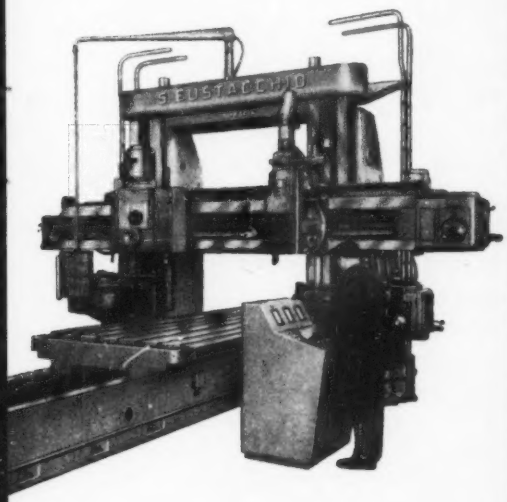

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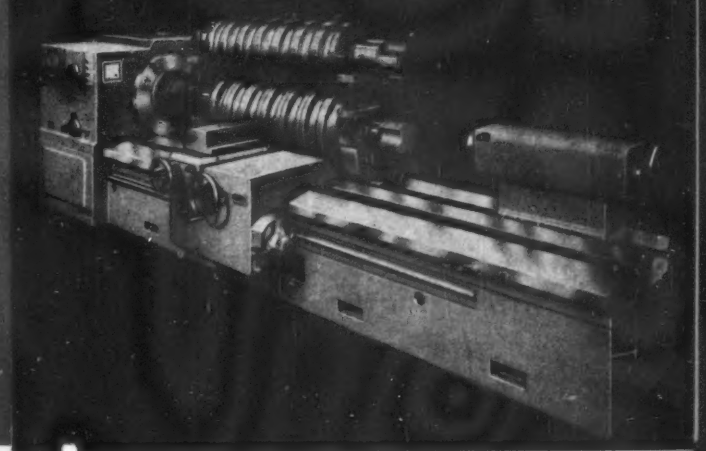

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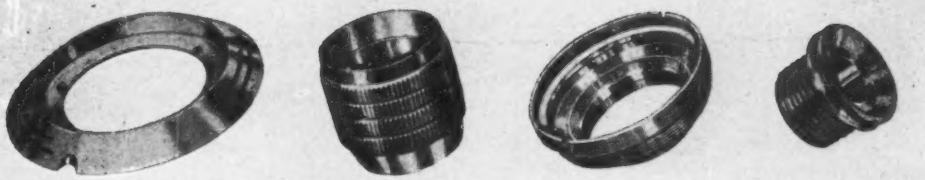

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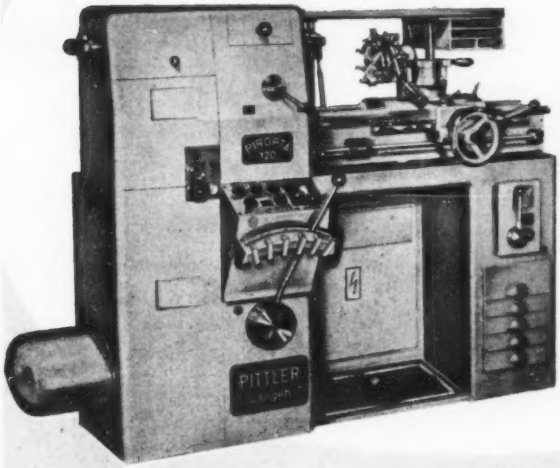

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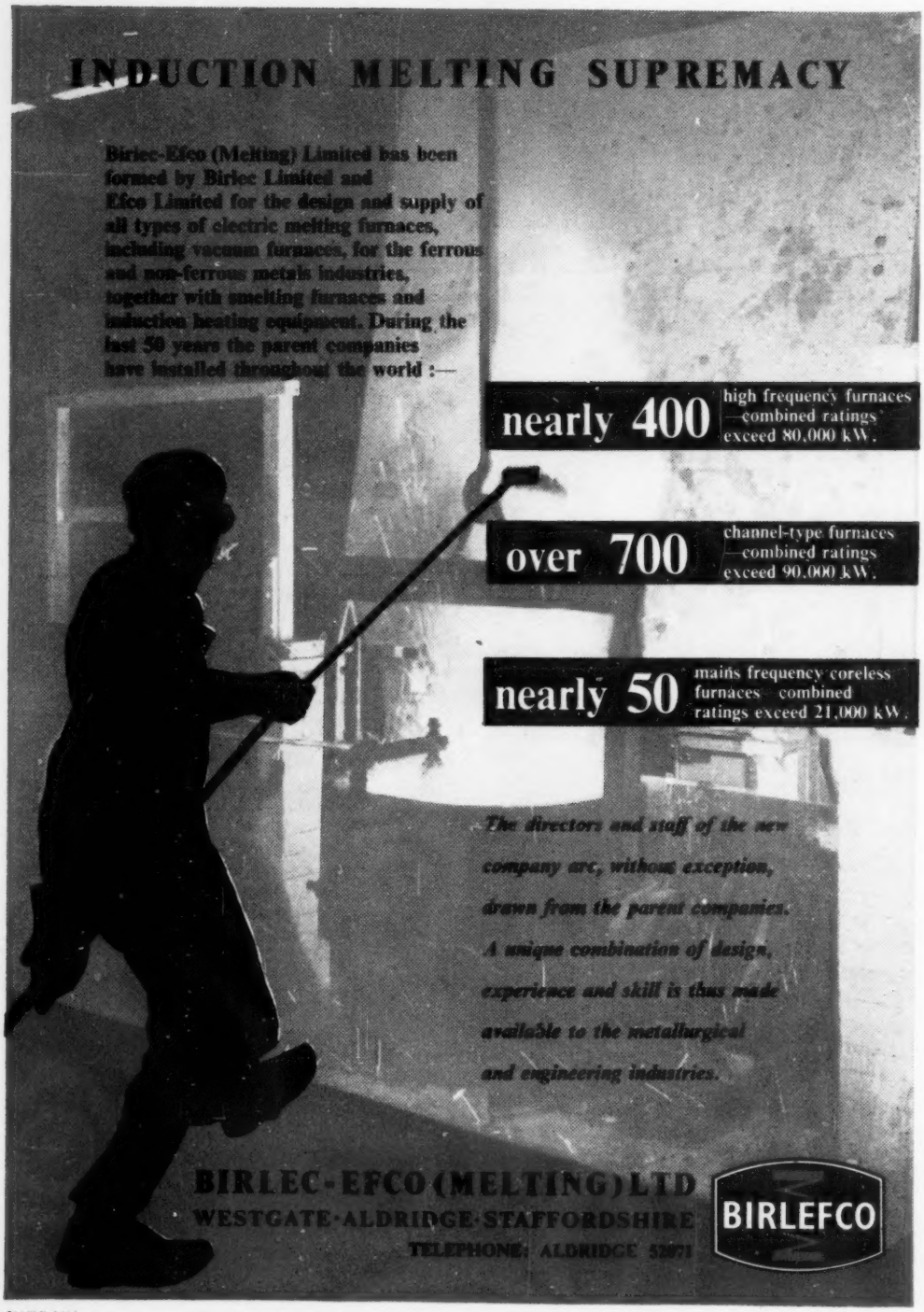
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Abstracts of Principal Articles

Making Type for Powers-Samas Accounting Machines ..... P. 1504

Machines in the range made by Powers-Samas Accounting Machines, Ltd., require up to 3,000 separate pieces of type, and this article describes the methods employed for their production. Characters are roll-forged on to the end faces of blanks in a special machine by means of interchangeable matrices, the manufacture of which is first discussed. After the character has been formed, the type body is trimmed, to remove flash, on a continuous machine with stationary cutters, and is then shaped to the required outlines by a series of broaching operations, for which standardized broaching elements are employed. De-burring is next carried out, special equipment being used for this purpose in certain instances. The position of the character on the end face of the body is subsequently inspected with a special micrometer, fitted with a knife-edged slide which is applied to the edges of the character in succession, under a magnifying glass. Case-hardening and final inspection complete the series of operations. Details are also given of the methods employed for the production of printing wheels by an engraving technique, which is still sometimes used for special characters. Gashes are hobbed in the wheel periphery, leaving platforms on which the characters are cut on engraving machines of special design, fitted with high-speed spindles. The character faces are then ground on another special machine and are inspected with a microscope at 25 × magnification. (MACHINERY, 93—31/12/58.)

Boma Dual-head Face Milling Machine P. 1512

Boma Engineering (Bilston), Ltd., Dixon Street, Wolverhampton, have recently designed and built a heavy-duty high-production dual-head face milling machine, which, although primarily intended for machining tractor track links, is suitable for a wide range of other work. A hexagonal rotary feed drum is employed, which is loaded continuously, and the two 5-in. diameter cutters are driven by separate 15 h.p. motors. Cuts averaging $\frac{1}{4}$ in. to $\frac{5}{8}$ in. deep are taken on the hard, tough, En43B material, and a machined component is unloaded every 58 sec. Single-stage helical reduction gears are employed for the cutter-spindle drives, and an axial adjustment of $\frac{1}{4}$ in. is provided for each cutter. An unusual feature of the worm drive for the feed-drum is a system of "live" preloading by means of a half-compensating friction-brake and screw device. (MACHINERY, 93—31/12/58.)

Cross Transfermatic Machine Incorporating Interchangeable Units ..... P. 1515

The latest type of Cross Transfermatic machine, for V-8 engine cylinder block production, incorporates standardized centre and side bases, heads, fixtures, and turnover and transfer mechanisms. Some particulars are given of a machine with 17 independent sections which complete a series of operations on such blocks at the rate of 350 per hour. The machine is built up from the standardized units, and design changes in the casting to be machined can therefore be accommodated for comparatively low cost. (MACHINERY, 93—31/12/58.)

Westinghouse Cypak Industrial Control Systems ..... P. 1521

The Cypak control system developed by the Motor and Control Division of the Westinghouse Electric Corporation, U.S.A., makes use of modules which incorporate a toroid core with two windings. Due to the hysteresis characteristics of the core material, there is a positive on-off effect in the electro-magnetic saturation of the core, so that the modules can be used to replace conventional relays. Various types of modules are available, all of which are sealed into polyester blocks, and the modules can be plugged into standard power channels to build up complete switchgear panels. It is claimed that this system affords important advantages as regards reliability and space, and is used in conjunction with contactless limit switches, of the lever-operated and proximity types. (MACHINERY, 93—31/12/58.)

Control of Die Casting Quality Standards P. 1531

In the introductory portion of this article, some characteristics of die castings which do and do not lend themselves to statistical control are briefly discussed. Next, dimensional variations across the parting plane are considered, and it is explained how they may be reduced by making provision for heavy flash of limited area. The importance of maintaining a survey of product quality at the machine is then explained. Other sections of the article are concerned with die temperature, the desirability of minimizing the thermal gradient; and die lubrication and ejector design. (MACHINERY, 93—31/12/58.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

IN FORTHCOMING ISSUES

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The Growing Importance of Chemical Machining

In a recent issue of MACHINERY, attention was drawn to some advances in the field of electro-chemical machining which are likely to prove of considerable value in connection with the solution of fresh problems that are constantly arising as a result of the introduction of new materials, particularly for aircraft and missile components. The difficulties of production departments had already been greatly increased as a result of the demand for integral structural components of growing complexity. Frequently these components are of large dimensions and must be made to fairly close limits of accuracy and with good surface finish. If they are to be machined by orthodox methods, such parts may require long and elaborate operating cycles, and although the work may be greatly facilitated, in many instances, by the use of tape controlled equipment, it is often preferable to employ the process usually known as chemical milling, either alone or in combination with established procedures. It appears that chemical milling should be regarded as complementary rather than as an alternative to electro-chemical machining. With the latter process, much more rapid, localized metal removal can be obtained, but compensation for the slow rate of penetration with chemical milling may be afforded by the fact that very large areas can be subjected to attack at one time.

As an example of the effective application of chemical machining, Mr. L. B. Stearns, during the course of a paper read recently before the American Society of Tool Engineers, mentioned bulkheads employed in the construction of large missiles. Since these bulkheads also serve as the heads of fuel tanks, they are commonly of spherical, conical, or parabolic shape. They are produced, in diameters up to 13 ft., by flow turning, machining to improve surface finish and uniformity of gauge, and chemical milling for local thickness reduction to remove all surplus weight. It was stated that in a finished bulkhead thickness may range from $\frac{3}{16}$ to 0·020 in. with stepped or tapered transitions, and limits of $\pm$0·003 in. Obviously the difficulties of obtaining such a result by conventional machining would be very great.

Hitherto, the complications associated with the production of intricately sculptured forms by machining have been concerned not so much with the actual removal of metal, but with the need for removing specified amounts from specified areas. With the demands, which are now beginning to be made, for equally elaborate components in materials which are inherently very difficult to machine by conventional techniques, the problems and costs of production are obviously multiplied. Some indication of what may shortly be required was afforded by Mr. R. W. Runyan in another paper presented at the same A.S.T.E. meeting. He described how various operations, including tapping, are being carried out "in production" on steel with a tensile strength of 260,000-293,000 lb. per sq. in. and a Rockwell C hardness of 52-56, and mentioned that steel of 350,000 lb. per sq. in. tensile (72 Rockwell C) was already being machined in the laboratory. "Now," he said, "we hear talk of 400,000 lb. per sq. in." Another speaker at the meeting, Mr. R. R. Ferguson, discussed the production of aircraft structural components, including 12-ft. long sculptured wing skin panels, from Inconel X. It was the experience of his company that when machining this material metal removal rate was about one-fourth and tool life about one-fifth of those obtained on 4340 steel heat-treated to 180,000 lb. per sq. in.

Obviously, for alloy steels and other alloys with such characteristics, the attractions of chemical machining, where it is applicable, are proportionately very much greater than for the comparatively easily machined aluminium alloys. For this reason, a brief survey of some recent advances in this field, included in Mr. Stearns' paper, is of considerable interest. By early in 1956, he indicated, the problems associated with the chemical milling of aluminium alloys had been mainly solved. Attention was then directed to magnesium, which presented greater difficulties by reason of its highly reactive nature. As a result of experience already gained, however, and the concentration of research effort, rapid progress was made, and it was soon possible to proceed with the development of techniques applicable to the newer high-strength, heat-resistant metals and alloys. Some work was done on alloy steels and titanium alloys as early as 1955, but subsequent investigations were greatly complicated both by the nature and diversity of the materials which are already being adopted for certain purposes, or are the subject of serious consideration. A point has now been reached, how-

(*Continued on page* 1555)

Making Type for Powers-Samas Accounting Machines

The methods employed by Powers-Samas Accounting Machines, Ltd., Aurelia Road, Croydon, Surrey, in the manufacture of their range of mechanical punched card accounting machines have previously been described in MACHINERY*. Some of these machines require more than 3,000 separate pieces of type which are held in curved "type sectors." Each sector contains up to 40 different pieces of type, which are held and located by slots in the sector walls. A tension spring, which engages with one wall of the sector, presses against a lug integral with each type body to hold the type face clear of the paper, as the sector swings up into position. When it is in place, a small hammer contacts the end of the type body to press the character, at the inner end, against the paper on the machine roller. The type is returned by its tension spring and the sector then swings downwards ready to be re-set for the next printing operation.

A wide variety of designs of type bodies has been evolved during the many years of development of the Powers-Samas system, to suit the numerous problems encountered. We may note, for example, bodies having up to three characters such as are employed in printing the months of the year or such shortened words as Mrs. Foreign language characters, too, often take up more space than do English characters, and, for this reason, the bodies are provided with enlarged heads, where necessary. The methods employed in producing them, however, are similar to those to be described in connection with type bodies having single characters. Before describing these methods, we may first consider the special machines and techniques employed in making the matrices whereby the characters are rolled on to the end of the type blank.

* 82/279-13/2/53; 82/533-27/3/53; and 82/655 10/4/53.

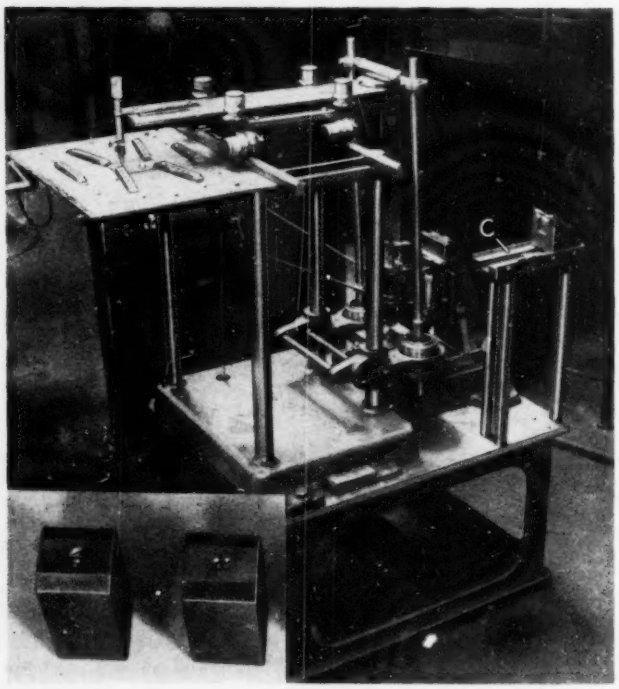


Fig 1. Special engraving machine for cutting matrices employed in type rolling, with a reduction of 20 to 1. Typical matrices are shown (inset)

MAKING MATRICES

At the first stage in producing a matrix, examples of one of which are seen inset in Fig. 1, a brass letter plate is cut. This work is done on a Taylor Hobson type C.X. engraving machine by tracing a drawing of the required character. A reduction of 3 to 1 is obtained from the drawing to the engraved brass plate in which the character is usually 2½ in. high, although the size varies slightly with the particular character. A further reduction in size in the ratio of 20 to 1 is effected in the final engraving of the matrix, for which the special machine illustrated in Fig. 1 is employed. This machine was made to Powers-Samas specification by J. H. Shand, Ltd., and is a development of an original American design.

The brass letter plate cut on the Taylor Hobson machine is fastened to the table of the matrix cutting machine by means of clamps, and is positioned centrally with reference to lines scribed on the table surface. A follower, having a shaped end to fit into the groove in the brass plate, is supported at one end of a slide above the table. This slide has chamfered edges which are engaged by rows of V-grooved rollers supported on a platform. The lower edges of the pair of rollers nearest to the follower are machined with gear teeth, and these teeth engage with a rack on the underside of the follower support slide. By turning one of these geared rollers, on which a knurled portion is provided for the purpose, the follower slide is caused to move longitudinally.

A similar arrangement is provided for the support of the table, which carries the follower slide, except that the rollers are here mounted on horizontal axes and run on transverse V-guideways to move the follower sideways when another geared roller is turned by hand. By suitable movements of both vertical and horizontal knurled rollers, the follower is caused to trace out the groove in the brass matrix smoothly. Movements of the follower are imparted to the opposite end of the slide which carries a horizontal bearing sleeve.

Housed in this bearing is a spindle which has a ring at each end. Supported at two points within each ring is a bush in which a vertical cylindrical bar is a sliding fit. The upper ends of these two bars are moved with the follower slide, and they serve to transmit the follower movements to the engraving mechanism located beneath the slide. A close up view of this engraving unit is given in Fig. 2, and in the foreground, at A, may be seen the lower end of the nearer vertical bar.

Each of these bars is a sliding fit in two more bushes, arranged one above the other. The upper bush is gimbal-mounted in an annular housing fastened to the upright column which supports the follower slide. It is a composite bush comprising an outer and an inner component, the outer part being held in the gimbals.

The inner portion of the bush has a fine external screw thread which is engaged by a graduated threaded ring whereby the inner bush may be raised or lowered in relation to the centre of the gimbal mounting. Each end of the bore of the inner bush is relieved so that the effective length is very short, and the bar can therefore be moved to positions out of line with the bush axis when necessary.

The lower bush is mounted in a somewhat similar manner in another annular ring which projects from the side of the platform carrying

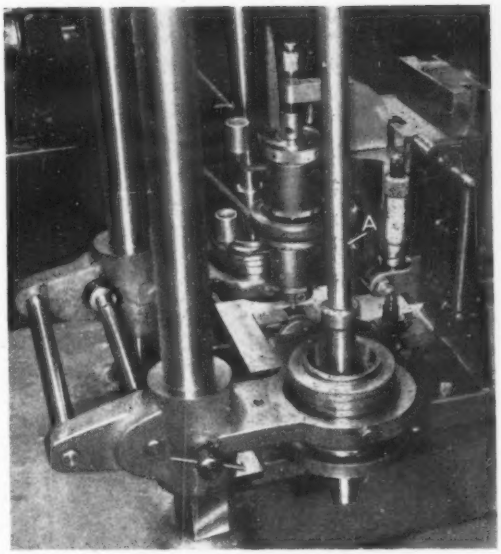


Fig. 2. Close-up view of the engraving head of the machine in Fig. 1. The cutter runs at 4,500 r.p.m., and is lowered into contact with the work by means of the micrometer head

the matrix to be engraved. Movements of the bar are transmitted directly to this platform, the upper bush acting as a fulcrum. The platform is mounted upon slide surfaces which enable it to move freely in any direction. Located by two adjacent sides in a nest in the platform, the matrix is secured in position by screw clamps acting on the other two adjacent sides. In operation, the matrix is moved past a high-speed steel cutter made from ⅛ in. diameter material which has four faces ground to an angle of 37½ deg. and is mounted in a vertical head. Driven at a speed of 4,500 r.p.m., the cutter spindle has a lower taper thrust bearing and an upper plain bearing, and is carried in a housing which can be raised or lowered to bring the cutter into contact with the work. A standard micrometer barrel is employed for accurately setting the cutter height in relation to the matrix and cutting is completed in four stages, the cutter being lowered beween cuts in increments of 0·015, 0·006, 0·003 and 0·001 in. In addition to the character cavity, a small pointed depression is cut below it in the matrix face and on the centre line of the character. A small projection on the type head is thus produced which is later employed to ensure that the body is positioned

correctly in the fixture for the first broaching stage.

When producing type, the character is rolled on to the blank as will be described later, and a device is fitted to the machine for producing the 0·75 in. radius required on the character face, as specified in the detail drawing, Fig. 7. For this purpose, a small roller, carried in a cradle, is provided beneath the micrometer anvil. The cradle is carried on four bearing balls which rest in a groove in the moving platform carrying the matrix. As the platform moves with the follower in the longitudinal direction, the cradle is caused to rock, and the cutter therefore follows a curved path, the highest point of which corresponds to the centre of the character in the matrix.

The attachment mounted on three legs on the right-hand corner of the machine base in Fig. 1 is designed for sharpening the cutter when necessary. The spindle housing is removed from its carrying slide and placed on guides at *C*, in contact with an adjustable stop. This brings the cutter into position above an angular hardened surface which serves as a guide for a flat sharpening stone. This stone is applied to all four surfaces in turn, the cutter spindle being fitted with an indexing device to ensure symmetry. After cutting, the matrix which is made from tool steel containing tungsten, is checked and hardened and is then ready for type production.

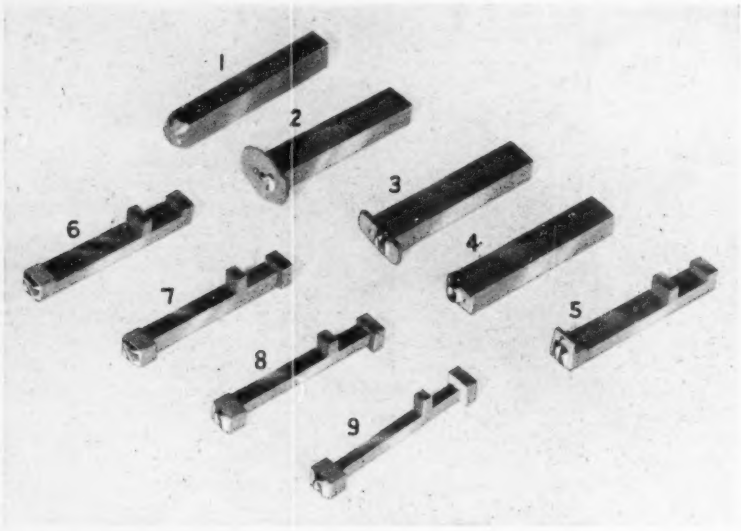


Fig. 3. The nine stages in the production of a type body. After rolling, four broaching operations bring the shank to the required dimensions

MAKING TYPE

In Fig. 3 are shown nine stages in the manufacture of a typical type body of fairly recent design. Such bodies, bearing standard characters, are usually made in batches numbering up to 500 pieces from non-free-cutting mild steel rod. The rod is specially made to cross-section dimensions of 0·125 by 0·170 in, with faces square to each other and with a hardness of 180 to 220 V.P.N. (30 kG. load). Blanks are cut from the bar and one end is chamfered on an automatic screw machine, after which the character is rolled on to the face at the chamfered end.

A special rolling machine, made by the Basil Engineering Co., Ltd., is used, and, as seen in Fig. 4, has a cast iron bed of very rigid box section. A heavy crankshaft with a central throw is carried in substantial plain bearings attached to the underside of the bed. Above the bed, at the left hand end, there is another shaft carried in similar bearings and supporting a heavy-section beam. The crank throw is connected to the end of this beam and as the crank turns, one end of the beam is moved up and down. Power is transmitted to the flywheel on the crankshaft by a flat belt from the 1-h.p. motor, and the shaft runs at approximately 250 r.p.m. In a cavity in the curved end surface of the beam is carried the matrix (seen inset in Fig. 1) of the desired character.

Mounted on the right hand end of the bed is a heavy saddle casting which embraces the flat surfaces at each side and can be moved slightly in a longitudinal direction by a cam arrangement operated by the lever *D*. The abutment on the saddle is held firmly against the cam by long tension springs at each side of the machine. Carried in bearings in the saddle casting is another heavy shaft on which a second beam is centrally mounted, so that the curved end face is opposite to that of the beam previously described. This second beam is of composite construction as

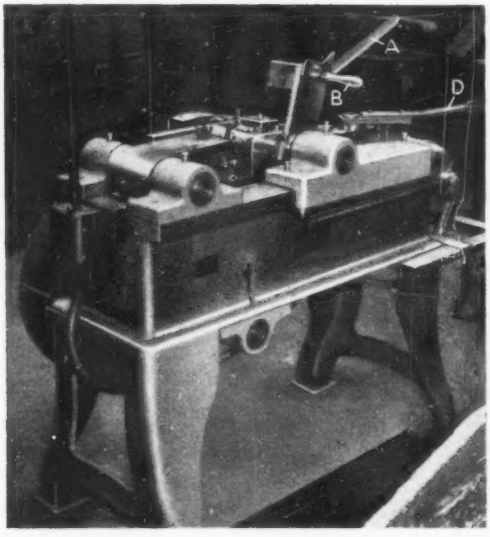


Fig. 4. A special machine designed for rolling the character on the head of the blank. Hand pressure is applied by means of the lever on the right

can be seen from Figs. 4 and 5. At the side remote from the camera, both beams are provided with meshing gear teeth so that as one is moved up and down by the crankshaft and connecting rod, the other moves with it.

The front edge of the right hand beam is cut away at one side and a curved block of metal is

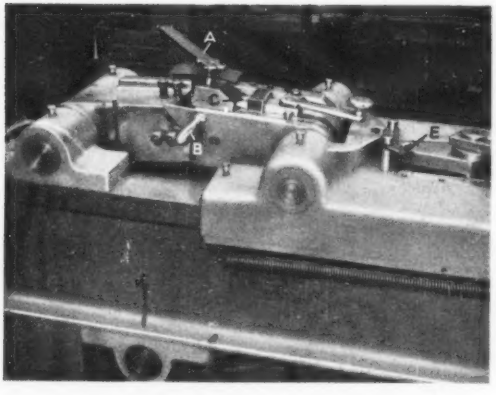


Fig. 5. Close-up view of the type rolling machine with the matrix and blank holders in position ready for the rolling operation

hinged on the beam shaft in such a way that it may be lifted up, as seen in Fig. 4, from the working position, in which it is located by a stop and held by a latch. In the end face of this block is provided a cavity of suitable size to accommodate the type blank, and a clamp, which is tightened by the lever *A*, Fig. 5, serves to hold the blank.

The machine is operated as follows. With the saddle in its extreme right-hand position, as may be seen in Fig. 4, the handle *B* is lifted to raise the curved block. The blank is then inserted and clamped by turning the lever *A*, before the block is lowered, as in Fig. 5. A lever-operated latch *C* is then moved into position above the lowered block to secure it to the beam, which is continuously oscillated. The lever *D* in Fig. 4 is then moved by the operator towards the centre of the

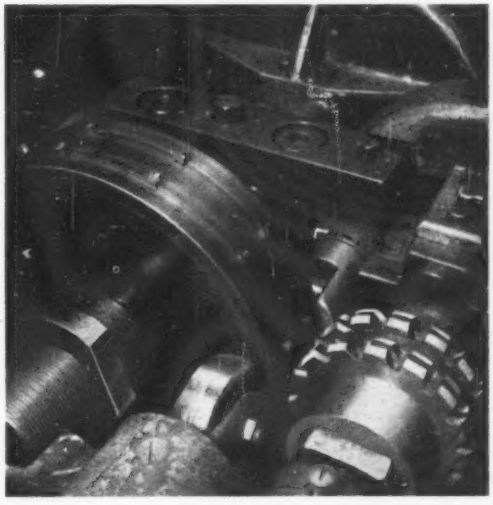


Fig. 6. A view of the adapted Ahcol screw slotting machine employed for trimming the flash from the rolled blanks. The workholding discs turn at 2 r.p.m. and the cutters are stationary

machine to close the beam ends together and press the projecting blank end against the front surface of the matrix. A stop *E*, Fig. 5, limits the movement of the lever. Pressure of the blank against the matrix causes metal to flow into the character cavity, and the surplus spreads over the matrix face as will be apparent on reference to stage 2 in Fig. 3. The rolling operation occupies about 10 to 12 reciprocations of the beams, and the blank length is reduced by approximately ¼ in. Some 6,000 to 8,000 blanks can be produced from

each matrix before it must be scrapped on account of wear.

After forming the character as described, the next two operations, which are carried out on one machine provide for trimming off the flash from all four sides of the head, as shown at 3 and 4 in Fig. 3. These operations are carried out on an adapted Ahcol (Dowding & Doll, Ltd.) screw slotting machine, a close up view of which is given in Fig. 6. The workholding device consists of a central 8-in. diameter disc with slots on each side of such a shape that the type bodies which are accommodated on one side are at 90 deg. to those on the other side.

At each side of this central disc and separated from it by a thin washer is mounted a thinner, hardened disc. Untrimmed pieces are fed into the slots on the right hand side (nearest to the camera) by the operator and partially trimmed blanks into the slots on the left, and as they approach the cutters the outer discs are pressed inwards by rollers to clamp them in position. The pieces pass between the cutters whereby the flash on two sides is trimmed away, and as the side pressure is released, they fall into containers beneath the discs. Pieces trimmed by the right hand cutters are transferred to the left hand slots for completion of the trimming operation.

When the machine was first employed for this work the cutters were driven, but it was found that better results could be obtained with cutters of the special form shown, which remain stationary. The flash is sheared off as the work is forced against the sharp edge formed at the periphery of the cutter which is ground to an angle of 25 deg. When the edges in use have become blunted, the cutters are turned to present fresh edges to the blanks. A ½-h.p. motor drives the discs through back gears and a worm and wheel to provide a final speed of 2 r.p.m.

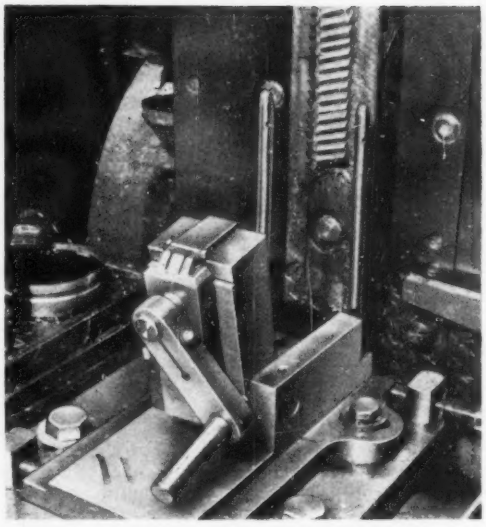


Fig. 8. One of the special machines and broaching fixtures employed for operations on the bodies. Broaches are assembled from segments

Following flash trimming several broaching operations are carried out to form the type body to the dimensions indicated in the detail drawing, Fig. 7, a completed piece, 9, being shown in Fig. 3. A close-up view of one of the vertical, mechanically operated broaching machines employed is given in Fig. 8, where the lower end of the broach and the clamping arrangements may be seen. Broaches are assembled in a holder, to suit the operation to be performed, from segments, each of which has 12 teeth. A range of segments is available, of various widths, and they are mounted together to form a broach up to 2 ft. 6 in. long. Each segment is ground to a similar height from the rear face to the teeth, and this dimension is

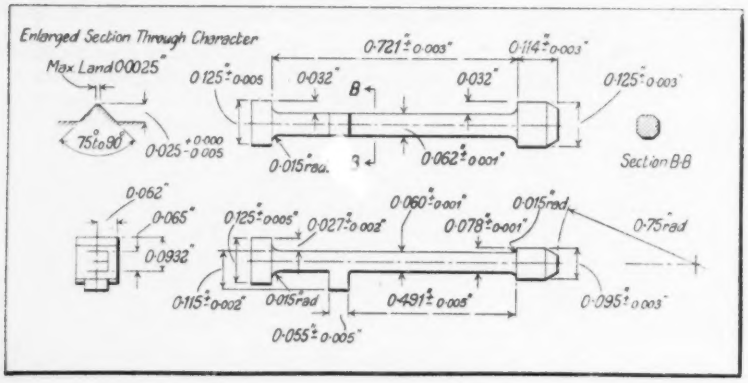


Fig. 7. Details of the "J Design" type body. Bodies for each character are produced in batches numbering up to 500

maintained throughout the segment length. To obtain the required tooth disposition the broach holder seatings are tapered and an average loading of slightly less than 0·001 in. per tooth is normally provided. During the downward stroke of the broach, which occupies a period of 4 seconds, a horizontally disposed revolving brush beneath the machine table cleans away the swarf from between the teeth and applies a coating of cutting oil, the supply of which is maintained by a drip feed. Different combinations of broach segments are successively employed to finish the type body to the required dimensions.

Similar work holding arrangements to those illustrated in Fig. 8 are employed on all the broaching machines. A heavy block of metal is hinged at one corner to the machine table, and is cut away at the other end to form a platform on which the type body rests. There is a simple captive clamp on one face of the block, which is actuated by a half-turn of a handle. This handle also serves to lower and raise the block on its hinge before and after cutting. At the set-up shown in Fig. 8 the body is broached to the required thickness and sized to length, the form, after this stage, being shown by example 7 in Fig. 3.

At the first broaching operation, for which a similar set-up is employed, the lug on the side of the body (stage 5, Fig. 3) is produced, and this lug is employed to locate the blank for subsequent broaching. Location of the blank for the first operation is obtained by inserting the head in a pad on one side of the hinged block. This pad contains a cavity of a shape corresponding to the letter on the type body and a smaller cavity to accommodate the pin point projection below the character, described earlier. It is thus ensured that the lug is correctly positioned in relation to the character. Following this initial broaching operation, the portion of the head bearing the small projection is milled away, and the three remaining broaching operations are then completed.

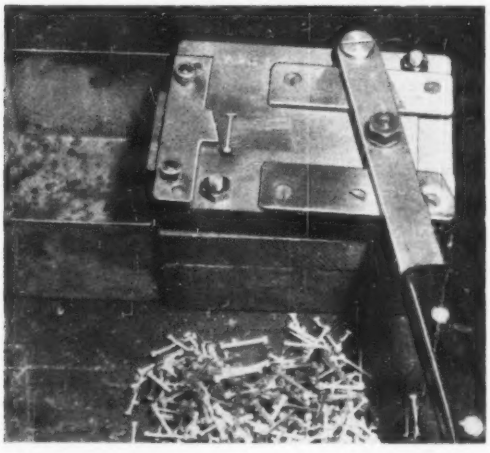


Fig. 9. In this flash trimming device, the component, held in a slot, is pushed against a guillotine edge which has a shearing action

Where possible, automatic fixtures are employed for de-burring between the broaching operations, and one of these is shown in Fig. 9. A sliding plate, moved by a lever, has a slot of suitable shape to accommodate the type body. As the plate is moved to the left, the body passes beneath a guillotine blade which shears away the burr. The body then falls out of the slot into the box as the sliding plate moves out clear of the base-plate.

When all the machining operations have been completed, a thorough inspection is carried out, including a check on the character position in relation to the body. For this test, a specially designed micrometer is employed fitted with a knife-edge slide. Horizontal movement of the slide is controlled by the micrometer spindle which is fitted with a large diameter barrel. The type is clamped to a vertical datum face with the character upwards. A magnifying glass is provided to enable the knife edge to be accurately positioned, successively above the edge of the type body and the portion of the character nearest to that edge, and readings are taken on all four sides of each sample.

After inspection, the type bodies are carburized, using a perforated basket, in a cyanide bath at a temperature of 780 deg. C., for a period of 8 minutes, and quenched in oil. This treatment gives a case depth of 0·0015 to 0·002 in., and after subsequent cleaning in a caustic solution the bodies are flash coated, in a barrel, with a 0·002-in. thickness of cadmium to prevent rusting. Subsequently the type bodies return to the inspection department where they are mounted in rows of 12 in a device whereby actual working conditions are simulated, and the characters are printed on paper. The shapes are then checked, also the line thickness, which should not exceed 0·005 in. on the impression produced from a new character.

MAKING PRINTING WHEELS

Instead of separate type bodies, wheels with type characters on their peripheries are employed in a machine known as an Interpreter to print on punched cards, information derived from holes therein. Two different methods are employed in forming the characters on the periphery of a wheel, namely engraving and cold rolling. The latter

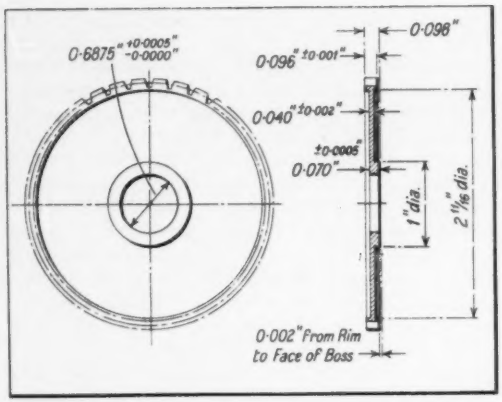


Fig. 10. Details of the printing wheel for an Interpreter machine. Characters on the periphery are produced by engraving or cold rolling

method was fully discussed in MACHINERY, 85/322—13/8/54, and is now employed for the majority of the wheels produced. Small quantities of special wheels, however, are still engraved by the procedure here described. A drawing of a typical wheel is given in Fig. 10. After being pierced and blanked from half hard mild steel strip 0·120 in. thick, the wheels are annealed, and subsequently flattened and ground to a thickness of 0·105 in. ±0·001 in two operations. Next the blanks are reamed to bring the bore diameter to 0·6875 in. +0·0005 −0·000 and the outside diameter is turned to 2·948 in. +0·001 −0·000, and concentric with the bore. Held by the outside diameter, the blanks are then faced to 0·096 in. ±0·001 at the rim, and the recesses are turned. Next, the wheels are inspected and again flattened before the teeth are hobbed. These teeth, it may be noted, provide the means, in the final assembly, for turning the wheel in order to bring the appropriate type character to the printing position.

A special hob of normal design, but with alternate teeth missing, is employed to cut the 36 gashes required on a pitch diameter of 2·865 in., the circular pitch being 0·125 in. and the pressure angle 14½ deg. After hobbing, the top surface of each tooth is ground flat to a distance of 1·472 in. +0·000 −0·001 from the blank centre on the special machine shown in Fig. 12, the operation of which will be described later.

In Fig. 11 is seen one of the special engraving machines made by Redman's Engineering Co., which are employed for cutting the required character on the flat face of each tooth. Fitted with Boneham & Turner high speed spindles which are driven by ¼-h.p. motors through V-belts at 6,000 r.p.m., these machines are equipped with cutters of similar design to those previously described in connection with matrix cutting, but with the sides ground at an angle of 20 deg. The cutter spindle is mounted on top of a column in such a way that it can be raised or lowered by means of the knurled wheel *A*, in Fig. 11, and it is normally held down by a tension spring, against the stop formed thereby.

Mounted on the machine column is a bracket having a hollow spherical upper surface and resting in this hollow is a matching concave platform. The platform incorporates a framework whereby a work holder may be held and positioned relative to the cutter. The work holder comprises a baseplate with an upright and a side projection, made in one piece. A workholding mandrel projects from one side and two substantial washers are provided for clamping the blank in position, with an indexing finger, carried by the side projection, engaged in one of the gashes.

To the underside of this platform, and projecting through a hole in the bracket is secured a long bar which carries a stylus point at its lower end. Immediately below the stylus there is a platform on which a matrix is held in a quick change device. The matrix has a raised character 0·625 in. high and the stylus is moved round in contact with the sides of this character by the operator. Movements of the stylus, reduced in

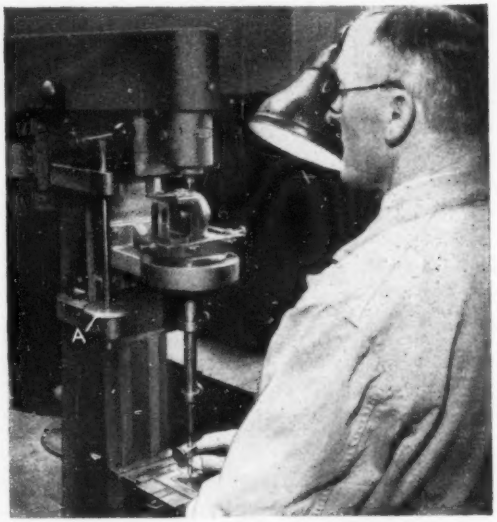


Fig. 11. One of the special machines for engraving printing wheel characters

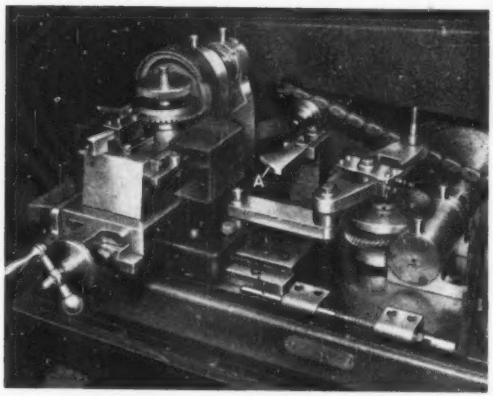


Fig. 12. Special automatic machine built by Powers-Samas for grinding the tops of wheel teeth before and after engraving the characters

the ratio of 6·25 to 1, are transmitted directly to the workpiece which moves in the opposite direction to the stylus. As the work is moved beneath the cutter, the surface is milled away, leaving the required character raised and in reverse. A slotted block, secured to the underside of the bracket, is engaged by a projection on the work-holding platform at the centre of the spherical surface to prevent the platform from turning during the milling operation.

After the characters have been engraved, the wheels are deburred by filing and brushing. Burrs are also removed from the top faces of the characters by a further grinding operation on the special machine, shown in Fig. 12, which was designed and built by the company. A much finer grit wheel is employed for this second grinding operation, at which 0·002 in. is removed to bring the distance from the character surface to the wheel centre to 1·470 in. +0·000 −0·001. A 3-in. diameter cup wheel is employed, which is driven at 6,000 r.p.m. by a ¾-h.p. motor. The same motor drives a large pulley on one end of the shaft of a worm which meshes with the worm-wheel seen on the right in Fig. 12. An eccentric pin on the wheel engages a slot in a lever, causing one end of the latter to move in a curved path. This movement is transmitted by a connecting rod to a table, which slides on V-guideways on the base plate. Additional V-guideways on the table carry a transverse slide which is fitted with a screw whereby the work can be moved towards or away from the wheel. An indexing workholder is mounted on this transverse slide and is actuated by the cam *A* as the table reaches the end of its stroke. The table is reciprocated at the rate of 44 strokes per minute so that the 36 faces are finish ground in less than one minute. The spring-loaded bar *B*, is moved to the right by the table during each stroke and its opposite end actuates a mechanism whereby the motor is automatically stopped after 36 strokes have been completed.

After engraving, the wheels are inspected with the aid of the fixture shown in Fig 13, in which they may be directly compared, by the aid of an O.M.T. microscope, at 25× magnification, with a master wheel of correct form. The most important requirement is that the characters should be central on the tooth faces.

Inspection completed, the teeth on which characters are not required are ground down so that they are 0·015 in. below the level of the top faces of the characters on the remaining teeth, and all the teeth are rounded by cutting chamfers of 0·010 to 0·015 in. on the outer corners to ensure smooth meshing with the driving wheels. Heat treatment involves immersion in a cyanide bath for 3 minutes followed by oil quenching, after which the wheels are carefully flattened and dull nickel plated before the part numbers are etched and they are finally subjected to a further inspection stage.

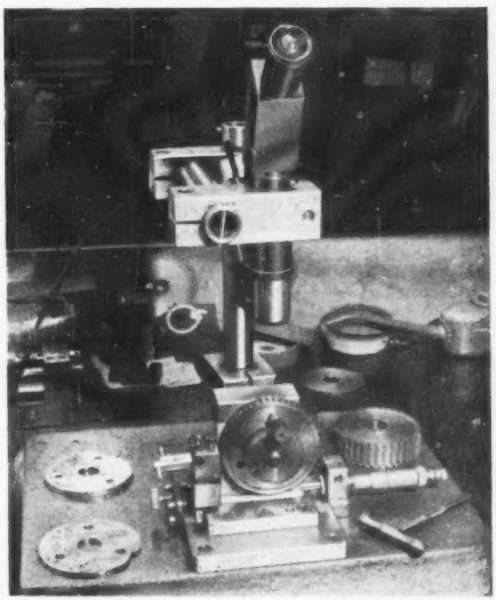


Fig. 13. Inspection fixture designed for checking printing wheels and correcting location holes where necessary. A 25 × microscope is provided

Boma Dual-head Face Milling Machine

Boma Engineering (Bilston), Ltd., Dixon Street, Wolverhampton, have recently designed and built for Tractor Spares, Ltd., the heavy-duty, high-production, dual-head face milling machine shown in Fig. 1. Although the machine is primarily intended for milling tractor track-link forgings in En. 43B material, with a hardness of 94 to 98 Rockwell B, it is suitable for a wide range of other work. With only slight modification to the basic design, moreover, it could be supplied in a single-head version. In the form here discussed, it has a hexagonal rotary feed-drum, equipped with a series of fixtures, which are loaded continuously at the front. From the loading station, the components are carried upwards, away from the operator, and downwards at the rear, between opposed 5-in. diameter cutters, which are run at a speed of 265 r.p.m.

To deal effectively with the exceedingly tough, hard material of the links, special Prolite Futur cutters are employed, each of which has 10 inserted carbide blades. These blades are of octagonal shape, and the clamping arrangements are such that they can be indexed and turned over, to present fresh cutting edges. Since a negative rake of 5 deg. is employed, and the edges are ground square to give a similar clearance angle, 16 settings of the blades can be obtained before regrinding is necessary. The mean feed-rate is 13 in. per min., and each cutter removes from ¾ in. to $\frac{5}{16}$ in. of material, the depth varying with the draft of the forging. Each fixture is designed to locate the rear end of one component, and the forward end of the next, as shown in Fig. 2, and the distance between the ends is kept to a minimum, so that cutting is nearly continuous. A machined component is unloaded every 58 sec. The makers of the machine are of the opinion that this performance could probably be improved, and with this object, investigations are being carried out with various grades of carbide.

Each cutter is driven by a 15-h.p. electric motor, and to provide for the negative-rake milling of tough materials such as that mentioned, the machine is of exceptionally robust construction. The massive one-piece cast base has an average wall-thickness of 1⅜ in., and the heads are secured directly to it by bolts and tenons. Each head, also, is a one-piece casting, with a wall-thickness ranging from 1⅜ to 1½ in., and with all bosses heavily ribbed. To ensure axial rigidity of the cutters, the heads are coupled together by the 4-in. diameter tie-bar seen in Fig. 1 and 2, and, as may be observed, this tie-bar is situated as close to the cutter axes as is practicable.

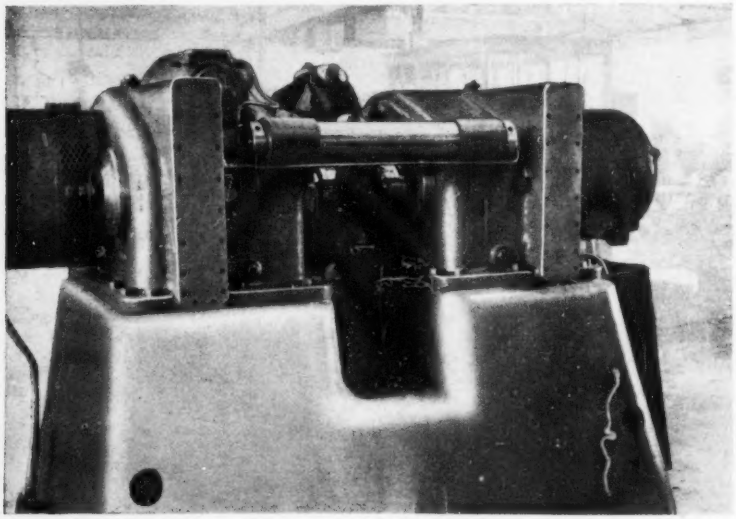


Fig. 1. A rear view of the Boma heavy-duty high-production dual-head face milling machine

Details of the cutter-spindle and drive are shown in the sectional view in Fig. 3. Each main drive motor is mounted externally on the outer end of the head, as seen in Fig. 1, and runs at 960 r.p.m. Speed-reduction, to the cutter r.p.m. already indicated, is obtained by means of the pinion *A*, Fig. 3, and the large driven gear *B*. The pinion *A* is keyed directly to the motor shaft, and runs in Timken taper roller bearings, and the large

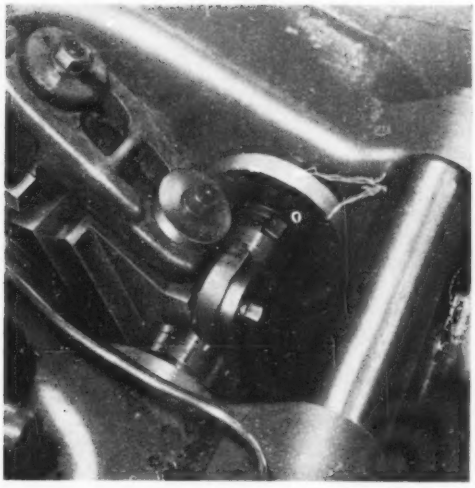


Fig. 2. Close-up view of the Boma milling machine, showing the cutters, work fixtures, and (right) the tie-bar that connects the heads

driven gear is splined to the spindle, and is clamped between the collars *C* and *D* by means of the slotted ring-nut *E*.

Single-stage reduction is adopted in order to take advantage of the flywheel effect of the large gear, to ensure smooth cutting, and the 15-deg. helical gears are so arranged that the end-thrust opposes the cutting load.

The rear end of the spindle is supported in two plain roller bearings, and the forward end runs in two opposed high-quality, precision taper roller bearings, which are preloaded. Adjustment of the degree of preload is effected by means of the nut *F*. Provision is made for approximately ½ in. of longitudinal adjustment for the position of the cutter, by means of the split collet *G*, which has a threaded portion *H*, engaging a corresponding thread in the spindle bore. Adjustment is effected by first slacking-off the nut *J*, and then rotating the sleeve *K*, by means of the integral collar *L*. The drive is transmitted through the dogs *M* to the collet, which is thus advanced or withdrawn in the parallel bore of the spindle nose. Once this adjustment has been made, the nut *J* is again tightened, and the taper shank of the cutter is thus pulled into the conical bore of the collet by the drawbar *N*, which is screwed into the end of the shank.

The hexagonal feed-drum is also of massive one-piece cast construction, with integral journals of 9 in. diameter, each of which runs in two plain bearings of Alzen (aluminium-zinc-copper) white bronze alloy. This bearing-alloy, it may be noted, is a product of Hill Alzen (Sales), Ltd., P.O. Box 22, Strings Lane, Willenhall, Staffs. Driven from the right-hand end by a 1-h.p. electric motor mounted in the base, the drum is located axially at this end only, to allow for thermal expansion. The driving motor unit, which was supplied by Electro-Power Gears, Ltd., incorporates a primary gear reduction system for reducing the speed to 9 r.p.m., and the output torque of the system is 508 lb. ft.

An Oldham coupling connects the primary drive to the input shaft *P*, of the worm-type final drive shown in Fig. 4. The large phosphor bronze worm-wheel, which has a pitch diameter of 17¼ in., gives a 52 : 1 reduction in conjunction with the hardened and ground steel main worm *R*. Of the single-

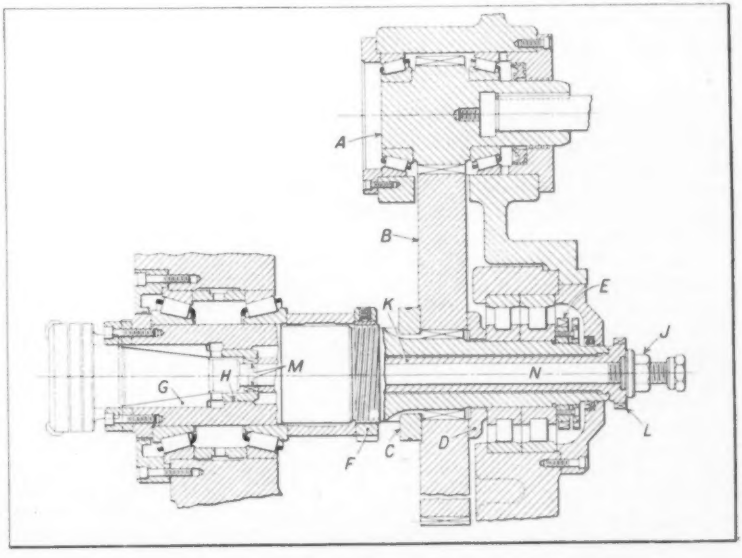


Fig. 3. Sectional view showing the cutter-spindle and final drive

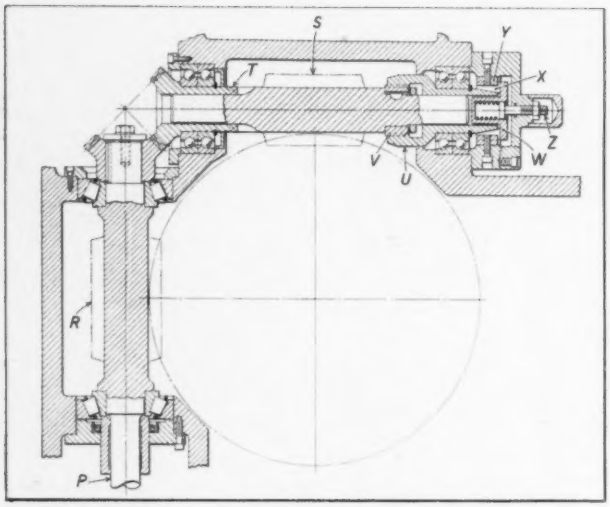


Fig. 4. Sectional view showing the worm drive to the feed-drum, and the "live" preloading system

start type, this worm has a linear pitch of 1 in., and the integral shaft runs in Timken steep-angle taper roller bearings. As may be observed, a second worm S is provided, which is driven through a pair of hardened steel bevel-gears, of 1:1 ratio, from the upper end of the main worm shaft. The function of this second worm is to provide a form of "live" preloading, to eliminate backlash, which is obtained in the following manner.

At the input end, the shaft of the secondary worm is free to slide axially in the bore of the driven bevel-gear, to which it is coupled through dogs *T*. At the opposite end, it is free to slide within the member *U*, which serves as a nut and engages an 8-start thread *V*. This nut is free to rotate in ball bearings, and a braking effect is exerted upon it by the spring-loaded flanged cup *W*, through the conical pads *X*, which are prevented from rotating by the keys *Y*. The spring pressure is adjustable by means of the screw *Z*. With this arrangement, the worm-shaft is constantly tending to screw itself out of the nut *U*, so that it is urged towards the driven bevel-gear, and it thus exerts a pre-load in opposition to the action of the main drive worm *R*. When the preload reaches a predetermined value, dependent upon the spring pressure, it is automatically limited by slip between the members *U* and *X*.

In order to accommodate any slight cyclic pitch-errors in the gears, and enable the preload to be kept as nearly constant as possible, the multi-start thread *V* has a helix-angle of 15 deg., which gives it a reversibility efficiency of 25 per cent, disregarding frictional effects. Thus, if the preload tends to become excessive, the shaft is displaced to the right, and the nut *U* is rotated slightly against the friction of the pads *X*. Similarly, once the "tight spot" has passed, any reduction in preload is immediately compensated. For ease of replacement in the event of wear, the thread *V* is cut on a collar, which is keyed to the secondary worm shaft, and secured by a nut. Any tilting of the flanged cup *W*, due to uneven wear of the pads *X*, is accommodated by a spherical surface on the head of the spring adjusting screw *Z*.

A built-in pump lubrication system is provided, the pump being driven directly by the cutter spindle drive pinion (*A*, Fig. 3) of the right-hand head. Oil is raised from a well in the bottom of the head, to a reservoir in the top, whence it is fed by gravity to the worm shaft bearings, and the main bearings of the cutter spindles in both heads. The feed-drum bearings are lubricated by wick feed, and all other bearings and moving parts by splash from the cutter-spindle gears. A balance pipe, connecting the lower well and the upper reservoir, maintains the same oil level in both heads.

THERMO-COMPRESSION PROCESS FOR CONNECTING LEADS TO SEMI-CONDUCTORS—A process known as thermo-compression bonding has been developed by the Bell Telephone Laboratories, U.S.A., to facilitate the attachment of leads to semi-conductors. With this process, a soft metal lead is pressed against the gold-plated surface of a semi-conductor, and moderate heat is applied. Adhesion is normally achieved in a few seconds, and, if required, leads may be attached to both sides of a wafer sumultaneously. Pressures normally range from 12,000 to 20,000 lb. per sq. in., and temperatures from 300 to 350 deg. C.

Where comparatively large contact areas are required, gold or silver lead wires, or 0·006 to 0·015 in. diameter, may be prepared by heading to 0·030 in. diameter. For smaller wires, the ends may be flattened in preparation for bonding. It is stated that the technique is being employed for attaching leads to diffused silicon diodes, and that specifications are being prepared for other applications.

Cross Transfermatic Machine Incorporating Interchangeable Units

Reflecting the concern of the motor car industry in the U.S.A. at the very high costs involved in re-equipment, when design changes are necessary, the latest Transfermatic automatic transfer machine made by the Cross Co., Detroit, incorporates many features designed to give greater adaptability in application. This new machine incorporates standardized components including unit heads, centre and wing bases, fixtures, and transfer mechanisms, and by changing only such minor parts as locating pins, clamping members and bushing plates, it could be employed for machining any V-8 type of engine cylinder block at present in production in the U.S.A. A diagram showing the layout of the machine is given in Fig. 1, from which it will be seen that it is composed of six sections, of which the first five are in triplicate, and the sixth in duplicate, to give the required output of 350 blocks per hour.

Each separate section in each line operates on an automatic cycle which is initiated by introducing a block to the entry position. In the first section, the block enters with the bottom face upwards and the operations include drilling the sump screw-holes, machining transfer pads on the sides, and drilling and chamfering certain holes in the under-face. Before leaving this section, the block is automatically inverted so that it rests on the sump face. On entering the second section, the block is turned through 90 deg. in the horizontal plane, and all the holes in the end faces are drilled and chamfered, the three oil gallery holes are pressure tested, and the camshaft bearing lines are rough-bored. The block is then turned again, to bring it into line with the direction of travel, before it is transferred to section three.

Here, the block is turned on its side, and the drilling of the holes in the under-surface is completed. In addition, the head faces are drilled, and the distributor hole is rough- and finish-bored. Crankshaft bearing cap and oil holes are also drilled in this section, and the block is then returned to the upright position to pass to section four.

In this section, the engine mounting pads are milled, the cylinder head faces are drilled, chamfered, and counterbored, and oil holes leading to these faces are drilled. During its passage through section five, the block remains on its sump face while the tappet holes are drilled, rough- and

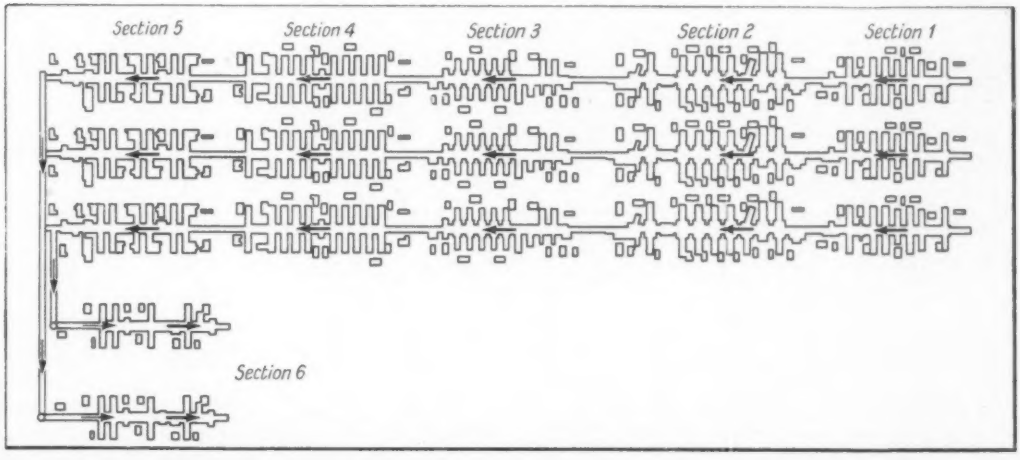


Fig. 1. Diagram showing the layout of the new Cross machine for operations on V-8 type engine cylinder blocks. The first five sections are triplicated, and the last is duplicated, to give an output of 350 blocks per hour

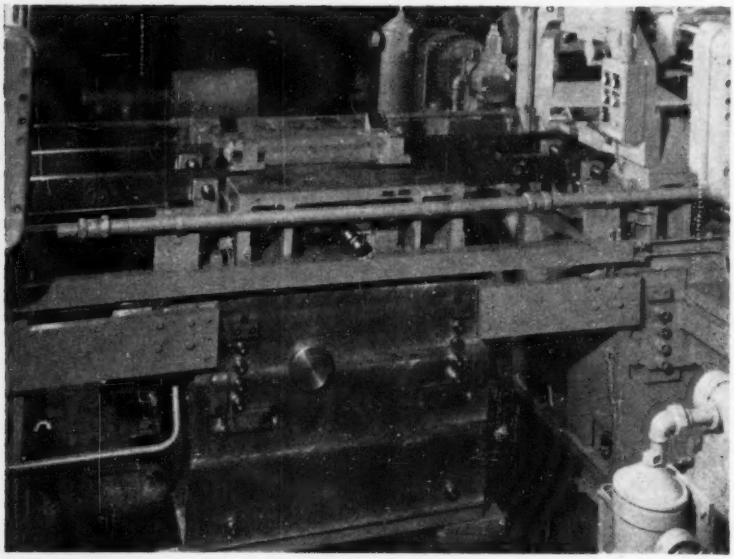


Fig. 2. A view of one of the standardized centre bases employed on the Cross machine showing the drilled face for the attachment of a side base to carry a unit head, and the transfer arrangement

finish-reamed, and inspected with air-gauging equipment. All the tapping operations are performed in section six, which the block enters in the transverse position.

After the end faces have been tapped, the block is turned through 90 deg. to the position which it occupies in the car, and the cylinder head and side faces are tapped. Towards the end of this section, the block is once more inverted, to enable the sump face and other side holes to be tapped, and all the holes are then probed as part of the final inspection procedure. The block leaves this section with the sump face upwards, ready for the assembly of the bearing caps. Occupying an area of 34,000 sq. ft., the machine performs a total of 2,291 operations on 185 blocks simultaneously.

To enable the machine to be designed for complete interchangeability of its components, as mentioned above, the Cross Company assumed responsibility for providing equipment for the complete series of operations on the blocks. This equipment included the machine units, the materials handling equipment, the conveyors, and much of the inspection equipment. As an example of the new units employed in the machine, a centre base is shown in Fig. 2, with

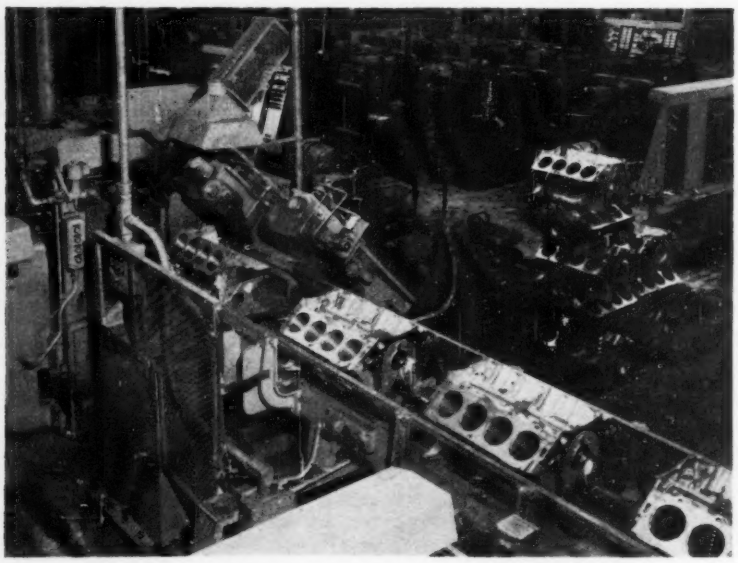


Fig. 3. On the cylinder block machine, three different standard mechanisms are employed for turning the blocks to the required positions. This view shows the unit for turning the block from its side to the upright position

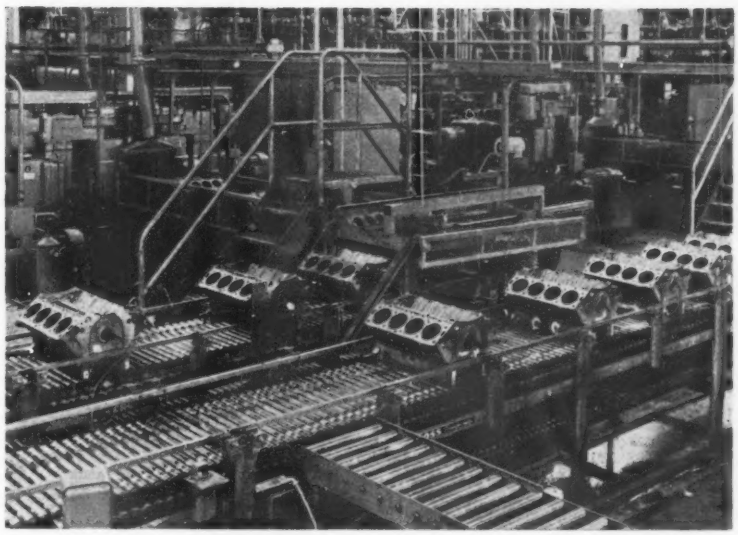


Fig. 4. Between machine sections, standardized conveyors are employed to transfer or store the blocks as required. This portion is installed between sections five and six where the three tracks converge into two

one side unpainted. Such a base is provided at each of the working stations throughout the machine, and it has drilled faces for the reception of the side bases which carry the unit heads. In addition, each centre base has lifting arms for the transfer mechanism which is arranged to rise, move sideways, descend, and return.

The arms carry short interchangeable lengths of transfer bar, which are joined at each end to the bars of the adjacent bases. On the transfer bars are fitted the non-standard, nest-type, holders employed to carry the castings from one station to the next, special holders being designed to suit the particular component. During the return movement of the transfer bar, these holders are below the level of the surfaces to which the casting is clamped. Four standard work-holding fixtures are employed on this machine, and are designed to hold the block casting in the four different positions mentioned above. Each fixture has been designed to accommodate wide variations in casting size, and for handling any V-8 type of cylinder block in current production, it is only necessary to change locating pins, clamping members, and bushing plates.

For turning the blocks to the various positions required for the machining sequence described, three standard handling units have been provided. One of these units, incorporating a pivoted beam, is seen installed at the far side of the machine section in Fig. 3. Rotatable trunnions engage the end surfaces of the casting, and turn it from the "side face downwards" to the "sump face downwards" position. Some of the total of 37 standard Cross control units for the efficient maintenance of the cutting tools on the machine are also seen in Fig. 3. These control units incorporate the well-known Toolometer dials which stop the machine section and give a signal to the setter when a tool change is necessary. Any section can be thus stopped without affecting the operation of the remainder of the sections.

Movement of castings between the various sections of the machine is effected by means of standardized conveyors. Provision is made for the storage of castings on accumulator conveyors between the sections. A view of part of the system installed between sections five and six, where the three lines of the machine converge into two lines for the final tapping operations, is given in Fig. 4. A shuttle conveyor receives the blocks from the three lines and feeds them to two accumulating conveyors. From these two conveyors, the blocks are fed to the two tapping sections on demand. Such components of the conveyor systems as escapement mechanisms, guide rails, and brackets are standardized, and installations can be arranged to suit any required plant layout.

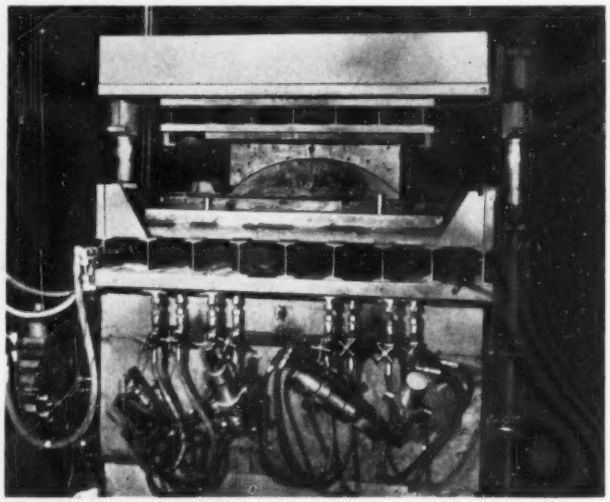
BRIGHT TIN PLATING PROCESS. The Tin Research Institute has developed a process whereby tin can be plated with a bright deposit, so eliminating the need for polishing or scratch brushing. Two main constituents are involved in the process, the brightener, which is made from wood tar by a special process, and a revivifying agent which is added to the bath when the brightness of the deposit begins to decline. The process is known by the name Brytin, and is marketed exclusively in England and Wales by Sonic Engineering & Equipment, Ltd., 120/130 Parchmore Road, Thornton Heath, Surrey.

Methods of Hot-sizing Titanium Parts

Smoothness of external surfaces on jet-propelled aircraft is of particular importance, but may be difficult to achieve with the high-strength, heat-resistant metals which are now being employed.

Fuselage panels, doors, and other aircraft parts with surfaces which are exposed to the air, are frequently supported by structural members made from titanium and other alloys, and trouble may be experienced in holding these members to the close dimensional limits that must necessarily be specified if the assembly is to conform to the desired contour.

For example, an aircraft nacelle panel which is fabricated at the works of the Ryan Aeronautical Co., San Diego, Calif., U.S.A., is approximately 12 ft. long and has a maximum circumferential width of 7 ft. The titanium sheet employed for this panel is only 0·016 in. thick and the assembly, comprising the skin and the structural members, must not weigh more than 150 lb. Any discrepancy in the curvature of a rib or other component will result in deformation of the outside surface of the panel, moreover, scratches on the external surface are not permissible. The problems of production are further accentuated by



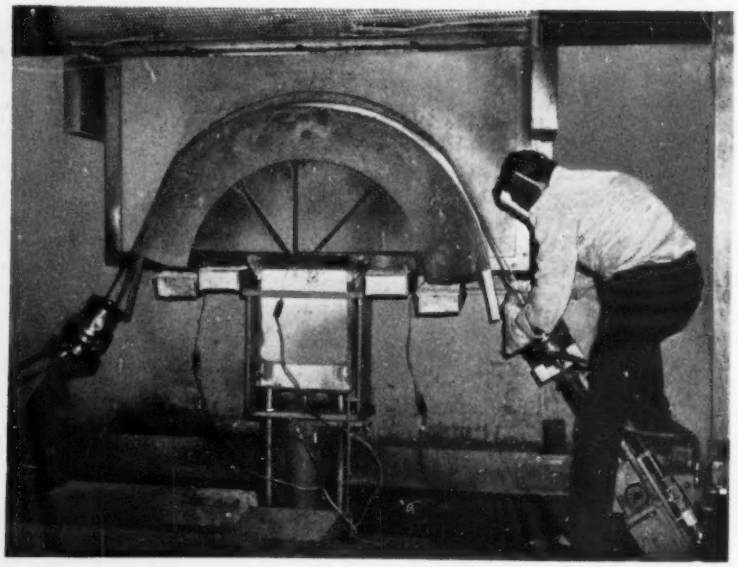


Fig. 1. (above). Set-up for a simple hot-sizing operation on a curved part. The hydraulic cylinders seen at the front of the press are employed for operating moving members of certain dies

Fig. 2 (left). One end of a titanium part that is to be sized by hot wrap-forming is here being attached to a pull-head on a special Hufford machine

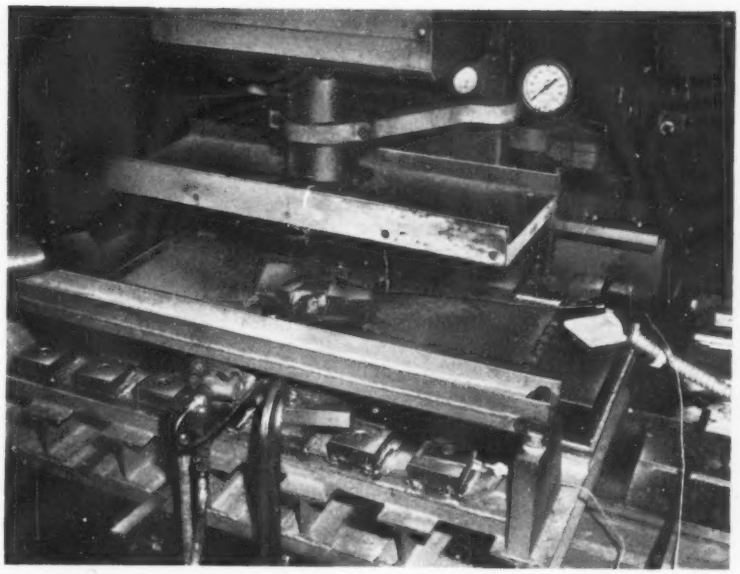


Fig. 3. At this set-up, one of the auxiliary hydraulic cylinders is employed to operate a die member

the fact that such panels must be interchangeable.

Leading edges of wings and other similar parts are also made from titanium at the Ryan works. The material most commonly used for such parts is AMS 4901 titanium, which is commercially pure.

To ensure the accuracy of titanium components produced on hydraulic presses and drop-hammers, they are subsequently sized by pressing them between heated dies for predetermined periods, or stretching them over heated forms.

One of the most interesting machines employed for such operations is the Hufford hot wrap-former shown in Fig. 2. This machine brings parts to final size, without wrinkles or deformation, by pulling them tightly over the same tools that were originally employed for stretch-forming on a standard type of machine. For hot-sizing, the form is mounted on a vertical table which is heated to a temperature of 1,000 deg. F., the heat being transmitted to the form and the work before an operation is carried out. It will be noted that the workpiece is attached to a hydraulically-operated pull-head on each side of the machine. Thermocouples on the form block indicate the temperature.

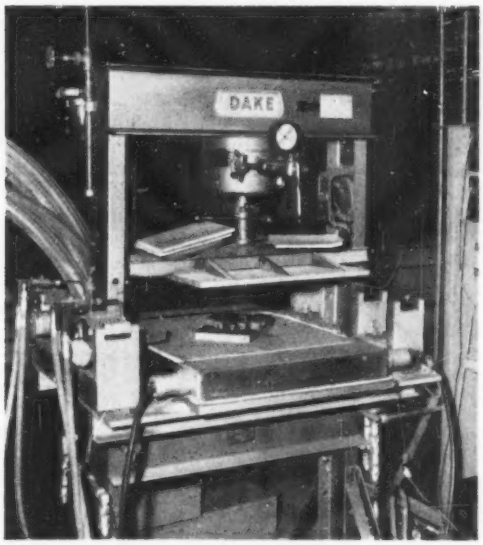


Fig. 4. Type of press employed for hot-sizing smaller titanium parts in dies that do not incorporate moving members

Parts can also be stress-relieved at this set-up. The time required for sizing and stress-relieving is about 30 min., and for hot-sizing only about 10 min. Some 600 pieces of titanium are handled per week with this equipment.

Other titanium components are hot-sized between two die members on the Hannifin hydraulic press seen in Fig. 1. This machine is equipped with a special, electrically-heated platen on which the bottom die member is placed, the heat being transferred to the work and the upper die member. For this operation, as for other hot-sizing performed in the works, the dies are preheated to 1,000 deg. F. This temperature is maintained while the tools are in use, and parts are held in the heated dies for 6 to 8 min.

Hydraulic cylinders, seen suspended at the front of the press, can be mounted horizontally on some

die-holding fixtures to operate sliding members employed when hot-sizing parts having flanges and joggles, or other surfaces that are irregular in outline. In Fig. 3, the end of one of these hydraulic cylinders is seen at the front of the press.

Each hydraulic cylinder has a projecting pin, which fits into a hole provided in a block welded to the table fixture. The ram of the hydraulic cylinder is connected to a toggle which closes hinged members of the die after the workpiece has been loaded, with the flanges and other vertical surfaces between the various portions of the tool. These hydraulic cylinders thus enable pressure to be applied from several directions in the horizontal plane, while the hydraulic ram of the press exerts downward pressure. The die parts must be made with an allowance for differential thermal expansion.

A Dake hydraulic press used for hot-sizing small components is shown in Fig. 4. To enable larger work to be handled, presses of this make, capable of handling dies up to 3 by 12 ft., were recently installed in the shop.

Titanium parts are trimmed after they have been hot-sized. For this work, it is necessary to keep the dies sharp and in first-class condition.

Ortho-Rater Visual Screening Equipment

The Ortho-Rater equipment shown in the figure provides a means of assessing quality of eyesight to facilitate the screening of persons, from an ophthalmic standpoint, for various occupations. The instrument does not serve for the detailed testing of vision for the purpose of prescribing spectacles. The results of tests that are carried out with the equipment, however, may indicate that eyesight is defective, and full ophthalmic examination by a qualified optician or medical practitioner should then be recommended.

Photographically-produced slides, which are normally stored in a slotted holder built into the base, are employed for 12 basic visual tests, seven for distant vision and five for near vision. Examinations are performed on each eye independently and binocularly. Two slots are provided in the side of the equipment to take different slides for testing for near and distant vision, and there are separate pairs of eyepieces through which the slides are viewed by the person being examined. The action of loading a slide into either slot causes a built-in lamp to be switched on for illuminating the slide.

When testing is being carried out, the slides are inserted, in turn, into the slots, and prepared

Ortho-Rater Visual Screening Equipment

questions relating to each are asked by the examiner. From the replies made by the person being examined, the results of the different stages of the test are recorded by marking numerals on a printed card. Upon completion of the test, a chart marked on transparent plastics material is superimposed on the card. These charts are supplied in various forms, with clear areas and coloured portions of different sizes, depending on the eyesight skills required for a number of occupations. If the numbers which have been marked on the card are visible through the clear areas of the chart, the eyesight of the person being examined is of the required standard for the particular occupation. When any or all of the numbers are seen through the coloured areas, an indication is afforded that more detailed examination of the person's eyes is either desirable or necessary. Each individual can be tested in 7 to 10 min.

The equipment is made by U.K. Optical Bausch & Lomb, Ltd., Television House, Kingsway, London, W.C.2, and is distributed by wholesale stockists.

PRODUCTION OF INDUSTRIAL AND AGRICULTURAL TRACTORS, of 10 b.h.p. and over, in the U.K. during July, August and September of this year reached a total of 29,993 units, and 20,592 units were exported. The average monthly value of tractors, parts and accessories delivered during this period was £6,658,000. The corresponding figures for the same period last year were 37,368, 27,826 and £6,937,000.

Westinghouse Cypak Industrial Control Systems

In an article published in MACHINERY, 92/653—21/3/58, describing the system of unit construction for transfer machines developed by John Bertram & Sons Co., Ltd., Canada, reference was made to the electrical control system supplied by the Canadian Westinghouse Co., Ltd., which incorporates Westinghouse Cypak units. The Cypak system has been developed by the Motor and Control Division of the Westinghouse Electric Corporation, U.S.A., and is claimed to offer a number of advantages. Among these advantages may be noted great reliability, since there are no moving parts to wear, break, corrode or burn out; extremely long life; adaptability due to the plug-in method of mounting the components; small size and light weight; and the good protection against dirt and moisture that is afforded by the sealed plastics housing in which the various components are contained.

An analysis of industrial relay systems has indicated that the major task of such systems is information processing rather than power switching. No matter how complex the information processing conditions, the operations performed by the relays can be described in terms of four basic "logic functions," namely, "and," "or," "not," and "memory." Relays perform these functions by means of specific wiring arrangements, whereas Cypak "modules" perform them by means of a patented Westinghouse magnetic amplifier circuit, with slight modifications for each logic function. In consequence, a combination of different Cypak modules can be employed to replace a complete relay control system.

The different logic functions may be explained with reference to the schematic comparison between Cypak modules and conventional relays which is given in Fig. 1. An "and" Cypak module corresponds to a number of relays in series. If signals are not directed to all the given inputs, as indicated at *a*, *b* and *c*, no signal will be delivered by the output *d*. With the corresponding relay system, all the normally-open contacts must be closed by energizing the associated relay coils, before current can pass. The input signals to the Cypak module can originate from any type of sensing unit—for example, a push-button, limit switch, relay or another Cypak module—and the output signal can be used to actuate a magnetic amplifier which has power-switching capacity to operate a contactor, solenoid, or other electromechanical unit.

An "or" module corresponds to two relays in parallel, and if a signal is directed to either of the given inputs, as indicated at *e* and *f*, a signal is delivered by the output *g*. With the corresponding relay system, the closing of either of the normally-open contacts allows current to pass from the input to the output side.

With a "not" module, an output signal will be delivered if there is no signal directed to the input *h*, and if there is an input signal, no signal will be delivered from the output *j*. In the corresponding relay system, the normally-closed contact allows

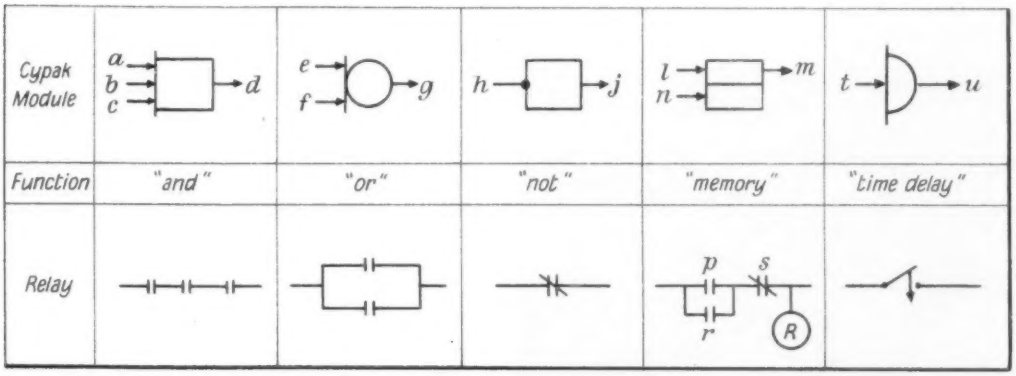


Fig. 1. Diagrammatic comparison between the basic types of Cypak modules and conventional relays with different contact arrangements

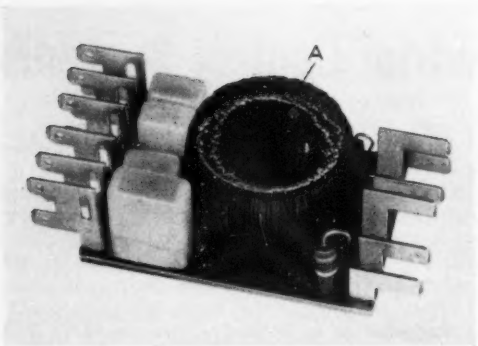


Fig. 2. The arrangement of a Cypak module is here shown. It incorporates a toroidal core with two windings, also resistors and rectifiers

current to pass until it is opened by the application of power to the relay coil.

When a signal is directed to the input *l* of a "memory" module, a signal is delivered from the output *m*, and will continue whether or not a signal continues to be directed to the input *l*, until a signal is directed to input *n*. In the corresponding relay system, once the normally-open contacts *p* have been closed, current passes to the hold-in relay *R* and the hold-in contacts *r* are also closed. Current can then flow through the hold-in contacts, regardless of whether the contacts *p* are closed or open, until the circuit is broken by opening the normally-closed contacts *s*.

In addition to the Cypak modules that have been discussed, there is also a "time delay" module, which is similar to a normal time-delay relay. When a signal is directed to the input *t*, a pre-set time will elapse and then a signal will delivered from the output *u*. All Cypak modules differ from conventional relays in one important respect. Whereas relays are actuated by one input signal, and can provide a number of output signals, Cypak modules can be actuated by any number of input signals and provide one output signal.

The construction of a Cypak module is shown in Fig. 2, and it incorporates a toroidal core with two windings, as indicated at A. Effective operation of the unit depends on the use of a grain-orientated magnetic alloy for the core, which has a hysteresis loop that approximates closely to the ideal square form for self-saturation. The material employed is Hipernik V, an alloy that is composed of approximately equal quantities of nickel and iron, and the square-loop characteristics of this alloy provide a positive on-off saturation of the core. Due to this effect, the function of the Cypak module closely resembles that of a relay, since the core is either saturated to the point where it will pass a signal, or is unsaturated so that no signal is given. Resistors and rectifiers are incorporated to control the saturation and to ensure that a signal can be passed in one direction only. Each Cypak module is supplied sealed in a solid polyester block, as seen in Fig. 3. Power connections are provided at one end, in the form of blades for engagement with sockets in Cypak power channel, which will later be described. At the end opposite to these blades, there are terminals for the input and output signals. These terminals are numbered and a diagram is printed on the outside of the block, to facilitate making connections and cross connections (in the case of "memory" and "time delay" modules). Power connections are not required for "or" modules, but these units are housed in the same type of block for convenience of mounting. The module shown in Fig. 3 is of the "not" type, but it also bears the name "½ memory," by which it is sometimes known. Various "and" modules are available with different numbers of input terminals.

Cypak modules are mounted on power supply channels which incorporate bus-bars for the transmission of the operating current. There are eight

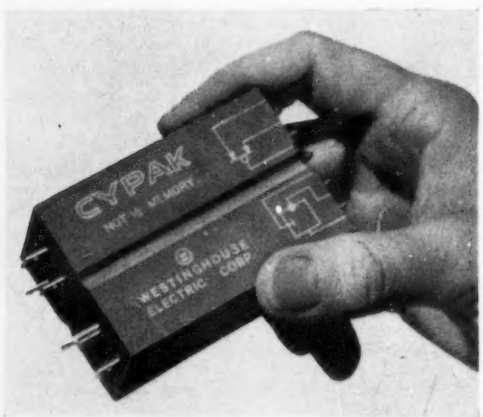


Fig. 3. A typical Cypak module. The electrical elements are moulded into a polyester block, and the compactness of the design will be noted

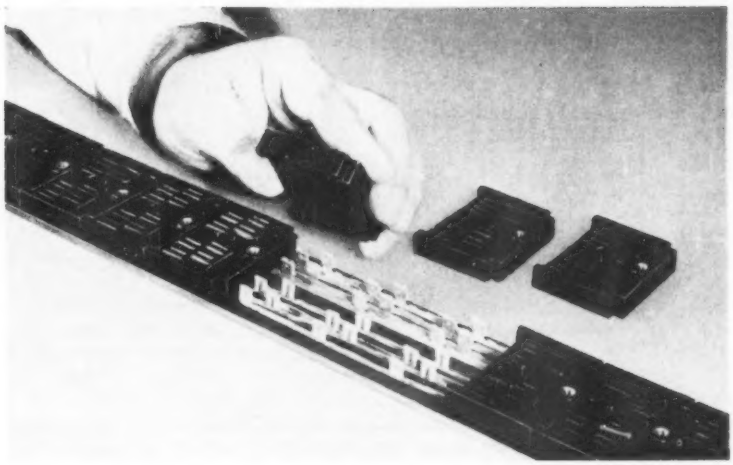


Fig. 4. A Cypak power supply channel with one of the plastics covers removed to show the bus-bars, which incorporate spring-sockets to receive the blades of the modules

bus-bars in each channel and, as shown in Fig. 4, each bus-bar has integral spring-sockets to receive the blades of the modules. The bus-bars are covered with interlocking plastics covers, with slots for the passage of the blades, and three of the covers are seen removed in Fig. 4. Each standard power channel will accommodate 15 Cypak elements, and power connections can be made at either end, or at some intermediate position. For installations that require less than 15 modules, the power channel can be cut to the necessary length. End caps are supplied to cover the exposed ends of the bus-bars, and extra terminal blocks for use with the cut-off lengths of channel are available. Power channels can be mounted side by side, or space can be left between them to accommodate wiring. Threaded holes are provided to receive long cheese-head screws whereby the modules are secured.

It may be pointed out here that phasing and polarity of the power supply are important for the correct operation of "and," "not" and "memory" modules. Each unit is marked to indicate the phasing, and power connections are arranged so that reversal of phase is effected by removing the entire unit from the power channel, turning through 180 deg., and plugging it in again.

The input for any Cypak unit should be at 15 volts, and a transformer is available which can be plugged into the power channel. Recently, new designs of push-button units and limit-switches have been introduced, which are suitable for the 15-volt supply, and are made without contacts, and in many instances without moving parts. A typical push-button is seen in Fig. 5, and two types of contactless limit-switches are shown diagrammatically in Fig. 6. The operation of both switches is based on the change in impedance of a coil. In the lever-actuated switch *B*, Fig. 6, a lever *D*, with a roller at one end, is adjustably mounted on a shaft, to which is secured the arm *E*. This arm carries a permanent magnet *F*, which is held in a certain position relative to the reactor *G*, when the switch is in the "on" setting, as shown. With the magnet in this setting, the core of the reactor is saturated, and it is desaturated when the arm is moved to the "off" setting, as indicated by dotted line. The proximity-type of switch *C* also incorporates a reactor *H* and a permanent magnet *J*. In this instance, however, the core is saturated and

Fig. 5. A typical push-button for the Cypak control system, which does not have any contacts

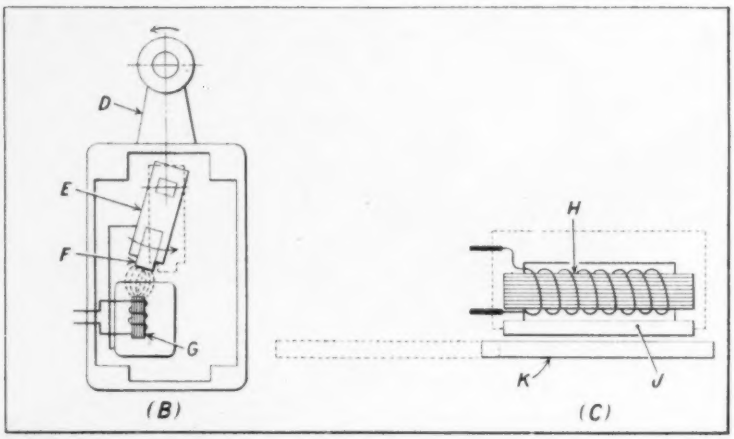


Fig. 6. Two types of Cypak contactless limit switches. The switch on the left is lever-operated, whereas that on the right is actuated by the proximity of a steel bar

desaturated by the movement of a steel bar *K* which is shown in the "on" position, with the "off" position of the steel bar indicated by a dotted outline.

Cypak modules are essentially low-power units, and the output signals from these units require amplification in order to operate contactors, solenoids, and other electro-mechanical mechanisms. Various output amplifiers are available, and are of the magnetic type. Cypak supply channels, magnetic amplifiers and other units can be mounted on standard panels measuring 23 by 14 in., and wall and floor mounted cabinets, to N.E.M.A. standards, are available to house different numbers of the standard panels. Cypak control systems have been applied to a number of machine tools, in addition to the transfer machine already mentioned. Among these machines may be noted a turret lathe, a precision honing unit (with automatic feeding, gauging, indication of stone wear, and segregation of parts), a press brake, a 110-ton press, and a boring mill.

Indicator for the Kopp Variable Speed Gear

The indicator shown in the accompanying figure has been developed by Allspeeds, Ltd., P.O. Box 43, Clayton-le-Moors, Accrington, Lancs., for use with their Kopp variable speed gears. Made from aluminium, it incorporates three number wheels which are visible through a Perspex window, and show the number of turns of the handwheel to one decimal place. Consequently, settings of the gear for particular speeds can be accurately repeated. The movement is transmitted through the indicating mechanism, and there is a clutch which ensures that excessive torque cannot be imparted to the shaft.

Where remote control is required, a flexible shaft can be provided between the indicator and the gear unit.

Although primarily intended for application to the Kopp gear, it is stated that the indicator can be adapted for use with other types of equipment and machines where accurate control settings are required, including full-way and diaphragm valves, and machine tools.

Indicator for handwheel settings on the Kopp variable speed gear

New Production Equipment

Craven Horizontal-type Turbine Pinion Hobbing Machine

Craven Brothers (Manchester) Ltd., Reddish, Stockport, have recently built the horizontal-type turbine pinion hobbing machine, here shown, for Empresa Nacional "Bazan" de C.N.M., S.A., Madrid, to complement a Craven 16-ft. vertical-type turbine wheel hobbing machine. It will cut pinions from 6 to 39 in. diameter, up to 2 d.p., with maximum face width and overall length of 9 ft. and 12 ft. 6 in. The drive is matched in ratio with that of the vertical machine to produce identical angles on mating gears, and the machine has similar characteristics as regards to accuracy and operation, being built to British Standard Grade A limits.

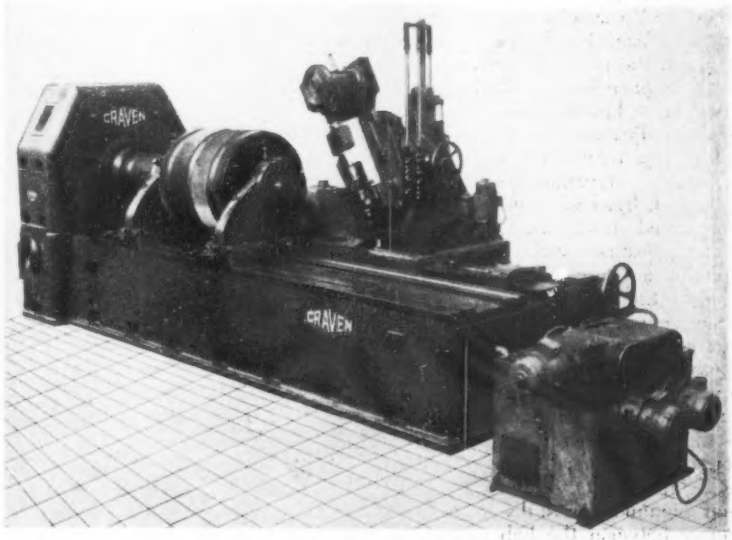
Guides for the hob slide are provided at the rear of the bed casting, and there are flat surfaces at the front of which two capped-type work supports are mounted. The latter are fitted with adapter bushes to suit the pinion journal diameters, and have both transverse and vertical adjustments for correction of alignment.

At the left-hand end of the bed there is a headstock with a 20-in. diameter cast-iron spindle which rotates in automatically-lubricated bronze bearings, adjustable for running clearance. A 10-in. diameter bore through the spindle admits extended pinion shaft ends, and provision is made for mounting a centre adapter and driving chucks.

A 60-in. diameter cast-iron master worm-wheel, secured to the spindle, is driven by a fine-pitch master worm, which is hardened, ground, lapped and polished. Axial loading in the worm drive is taken on special ball thrust washers. The worm is of dual-lead design, and can be adjusted axially for control of backlash without disturbing the centre distance of the drive or affecting the uniformity of transmission. Moreover, the backlash is uniform along the whole line of action for any setting.

Built as a separate unit, the main gearbox is mounted on a deep base-plate attached to the headstock end of the bed and houses all the gearing for hob speed changes, dividing, spiralling, feeds, and prime numbers. The gears totally-enclosed and running in oil. The various change gears and pick-off gears are enclosed in outer compartments with hinged covers.

Any number of teeth from 20 to 500 can be cut



Craven horizontal-type turbine pinion hobbing machine built recently for export to Spain

H

without the use of special gears, and the feed can be stopped, started or reversed, while the machine is running, without interfering with the position of the hob in relation to the teeth being cut. Rapid power traverse is provided for the hob carriage and can be used for rapid return, before taking a second cut.

The main drive is taken from a 10-h.p. constant-speed reversing motor through reduction gears and pick-off change gears which provide 10 hob speeds from 10 to 80 r.p.m. From the headstock, the drive is transmitted through a shaft in the bed, bevel gearing and a vertical shaft in the carriage, and, finally, through spur gear and worm reduction units in the hob slide. As a safeguard, two main drive motors are provided, and are coupled together in tandem. One is supplied from the normal A.C. mains, while the other is a D.C. type. In the event of failure of the first motor or of the mains supply, the D.C. motor is automatically started, and operates from a temporary battery supply until an auxiliary diesel-engined generating set can be started up to take the load.

Operation of the machine is by horizontal cutting only, and the hob slide is mounted on the front face of a substantial transverse slide, which has hand-operated micrometer adjustment, and rapid power cross traverse by a small independent motor, on the main hob carriage, for setting the hob in relation to the workpiece. Longitudinal feed traverse of the complete hob slide assembly on the bed is obtained through a precision master screw and a special nut, with means for eliminating backlash. Feed changes are made by pick-off gears in the main gearbox.

Of high-carbon steel, the conical hob spindle runs in a bronze bush with adjustment for taking up wear, and a heavy, dynamically-balanced, flywheel is incorporated in the drive. Axial adjustment of the spindle is provided to enable the hob to be accurately re-set for a re-cut traverse. The maximum outside diameter and minimum root diameter of the hob are 9 and 5 in. respectively, and the maximum length is 9 in. The maximum and minimum centre distances between the hob and work spindles are 24¼ and 3⅜ in.

Gears in the main gearbox and the master worm in the headstock run in oil baths. In addition, a constant supply of filtered oil is delivered by a motor-driven pump unit, from a large reservoir in the gearbox base, direct to the headstock spindle bearings, and to various bearings and gear trains in the box. A second motor-driven pump unit, operating from the same A.C. source of supply is provided as a standby in the event of pump failure, and a third unit, which can be operated from the auxiliary D.C. supply, affords a safeguard should the mains current be interrupted. An oil flow switch in the system gives warning of any failure, and ensures that oil is circulating before the machine can be started.

Another 3-pump arrangement is provided for the supply of cutting lubricant to the hob from a large tank at the end of the bed, and a magnetic filter is provided to remove fine swarf. A separate oil reservoir in the hob carriage serves for the lubrication of all the hob driving gears and the feed traverse nut. In this instance, there are two self-contained motor-driven pump units, one of which operates from the mains A.C. supply, and the other, when necessary, from the auxiliary D.C. supply.

Le Blond Centre Lathe for Contour "Chasing" Spiral Rotors

A 32-in. centre lathe built by the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, U.S.A., is shown in Fig. 1, fitted with special equipment developed by the company for performing contour chasing operations on spiral rotors for compressors built by the Roots-Connersville Blower Co., Connersville, Indiana.

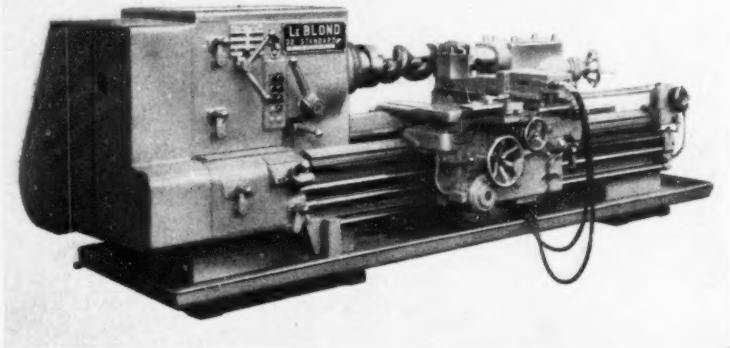


Fig. 1. Le Blond 32-in. centre lathe fitted with special equipment for performing contour "chasing" operations on compressor rotors

One of the rotors handled on this lathe has a lead of 10 in. and convex and concave lobe flanks. During the machining cycle, successive "chasing" cuts are taken on the flanks by a single-point tool, the sliding motion of the saddle being obtained by means of the leadscrew and an unusually long nut which are maintained in continuous engagement.

The cross-slide provides movements from 0 to ⅜ in. for tool relief at the end of each cutting stroke, and carries a template holder and a special longitudinal slide, on which is mounted a Hydra-Trace hydraulic copying slide. A close-up view of this arrangement is given in Fig. 2. At the beginning of each pass, the tracer stylus takes up a fresh position on the template, with the result that feed is applied to the tool along the work contour, for taking the next cut. In this way feeds can be obtained in steps up to 0·07 in.

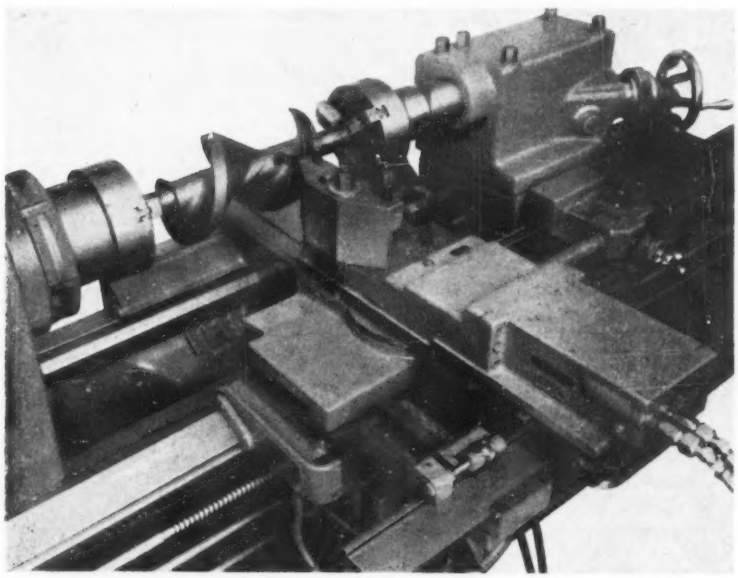


Fig. 2. Close-up view of the saddle on the lathe shown in Fig. 1

The lathe is designed for operation on an automatic cycle, and will handle spiral rotors with leads from 4½ to 16 in. Workpieces are held at both ends by 3-jaw chucks mounted on the headstock and tailstock spindles, and a work driver and locating pin are provided to avoid any possibility of slip while machining is in progress. Cutting is carried out away from the headstock on rotors with a left-hand spiral, and in the opposite direction when a right-hand spiral is being machined.

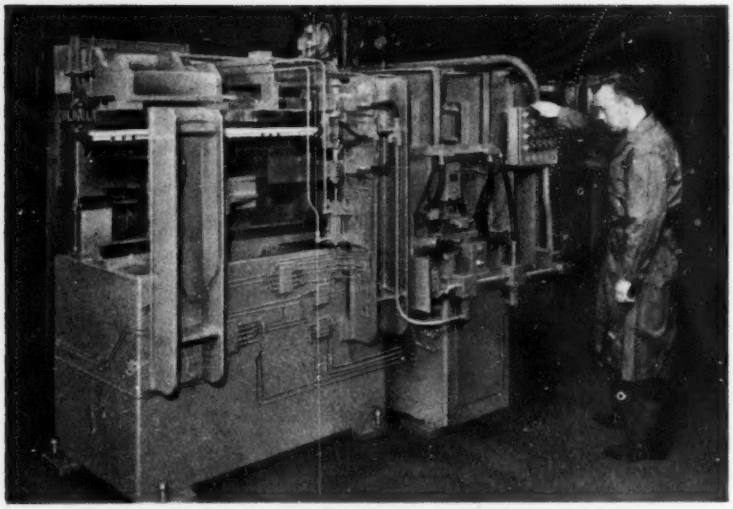
The distributors in this country for Le Blond lathes are Wickman, Ltd., Tile Hill, Coventry.

Colonial Automatic Horizontal Broaching Machine for Cylinder Blocks

The machine here shown has been developed by the Colonial Broach & Machine Co., Detroit, Michigan, U.S.A., for automatically machining the bearing surfaces of cylinder blocks. Designed for installation in an automated machine line, the machine is hydraulically-operated, and provision is made for automatic loading and unloading of the workpieces. The cylinder blocks are transferred horizontally through the machine, from left to right, and the broach, which has a stroke of 66 in., is arranged to move horizontally, the cutting traverse being from right to left.

Parts to be broached are delivered by a conveyor to the loading station at the left-hand end of the machine (as viewed in the figure), whence they are moved by two hydraulically-operated transfer bars on to the trunnion fixture at the centre of the machine. This fixture, which is hydraulically-powered, lifts the workpiece, and locates and clamps it in the required position for the broaching operation. At the completion of the broaching traverse, the cylinder block is lowered automatically, and is moved to the unloading station, in preparation for transfer to a conveyor on the exit side, while a fresh workpiece is delivered to the broaching position. The loading and unloading sections of the cycle just described can be manually operated, if required.

The ram is traversed in hardened and ground slideways, which are provided with adjustment for wear, and an automatic force-feed lubrication system is incorporated. The hydraulic and electrical circuits are interlocked in accordance with JIC standards, and all controls are grouped in the



Colonial automatic horizontal broaching machine for cylinder blocks

panel that is seen under the operator's right hand.

In a typical application of this machine, the bearing surfaces of cast iron cylinder blocks for motor cars are broached at the rate of 180 parts per hour, when the machine is operating at 100 per cent efficiency. With a broach traverse rate of 60 ft. per min. on the cutting stroke, and 100 ft. per min. on the return stroke, the cycle time for these blocks is 20 sec., and the joint faces are held to within 0·002 in. of the specified dimension. Carbide-tipped broaches are employed, and the depth of cut is 0·030 in.

Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11, are the agents in this country for the Colonial Broach & Machine Co., Detroit, Michigan, U.S.A.

Taylor-Hobson Turbine Blade Edge Microscope

To provide a relatively simple means of viewing the edges of turbine and compressor blades for checking the radii, and the blending with the blade flanks, Taylor, Taylor & Hobson, Ltd., Stoughton Street, Leicester, are producing a microscope of patented design, as here illustrated, which has a magnification of 40×, and can be used in full daylight. Any part of the edge can be viewed, within about ⅝ in. of the root or shroud, and errors of 0·001 in. are readily observed.

The microscope functions on the light slit principle, a narrow band of light being projected obliquely round the edge at the required cross-section and viewed obliquely through the microscope. Since the elements of the microscope are so arranged that the obliquites cancel each other, the image seen through the eyepiece is that of the normal cross-section of the blade. The observed shape is compared with a master drawing, at 20 × magnification, on a 3¾- by 4¼-in. card which is slipped into a holder on the instrument. This card is seen through the eyepiece at 2× magnification, and a total magnification of 40× is thus provided. A drawing scale of 20× often suffices, but for very small radii, it is preferable to prepare the drawing to a larger scale, and then reduce it to the required 20× by copying it photographically.

Taylor-Hobson turbine blade edge microscope

Blades up to 2½ in. wide and of any length can be handled, the smaller blades, up to about 8 in. long, being held against an inverted-vee mounting by means of a spring plunger applied from beneath. It may be necessary to hold longer, or very heavy blades, against the vee-mounting by hand. The brightness of the drawing image relative to the blade image is adjustable to provide the best conditions for both light and dark blade surfaces. Conveniently-placed adjusting screws permit the image to be quickly aligned with the master drawing. Since no eyepiece graticules are required, but only inexpensive and easily-prepared drawings, the instrument can readily be employed for inspecting blade edges of any form.

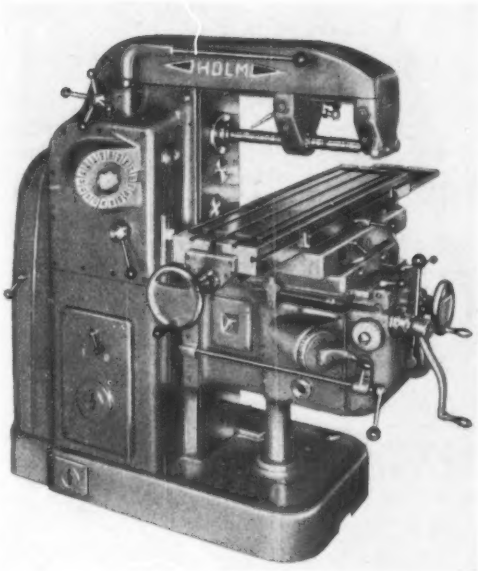
Holm Type 2U Universal Milling Machine

William O. Bullock & Sons, Ltd., 126 Rodbourne Road, Swindon, Wilts., have recently been appointed distributors in this country for the Swedish-built Holm type 2U universal milling machine shown in the figure.

The 49¼- by 11⅛-in. T-slotted work table has longitudinal, transverse, and vertical movements of 33½ in., 9⅞ in., and 17¾ in., respectively. Sixteen power feeds are available, ranging from ⅜ to 27 in. per min., longitudinally and transversely, and from ⅛ to 13½ in. per min. vertically, selection being made by means of a dial on the side of the knee. There are also rapid power traverses at the rate of 138 in. per min. in each direction horizontally, and 69 in. per min. vertically. A maximum distance of 17¾ in. is obtainable between the centre line of the spindle and the working surface of the table.

Conveniently-placed drum-type indicators are fitted, which have a measuring range from 0 to 4 in., and are used in conjunction with the micrometer drums on the traverse screws, to facilitate setting the saddle and knee. Moving parts housed in the knee are automatically lubricated by a built-in pump, and the screw for vertical movement runs in an oil bath. The traverse screw for the table engages with two nuts, which can be readily adjusted for eliminating backlash upon removal of a cover on the front of the saddle.

Drive is taken from a 7½-h.p. motor and 18 spindle speeds are available in each direction, which may range either from 20 to 1,200 or from 25 to 1,500 r.p.m. Alternatively, a 10-h.p. driving motor may be fitted, and the spindle speeds then provided range from 30 to 1,800 r.p.m. Any spindle speed in the range can be pre-selected by means of a dial on the side of the column, and is subsequently brought into use by movement of a conveniently-placed lever. This lever also operates a multi-disc clutch and a brake in the spindle drive. When the brake has been applied, the driving motor is automatically stopped after a time delay of 2 min. The spindle runs in three bearings, and has an American No. 50 nose.



Holm type 2U universal milling machine

A universal milling head is available, which can be supported by swivel brackets attached to the column, so that it can be readily swung into and away from the working position, as required, without the need for a hoist. A universal dividing head with a centre height of 5½ in. can also be supplied.

The machine occupies a floor space of 50¾ by 24⅜ in., and weighs approximately 2 tons.

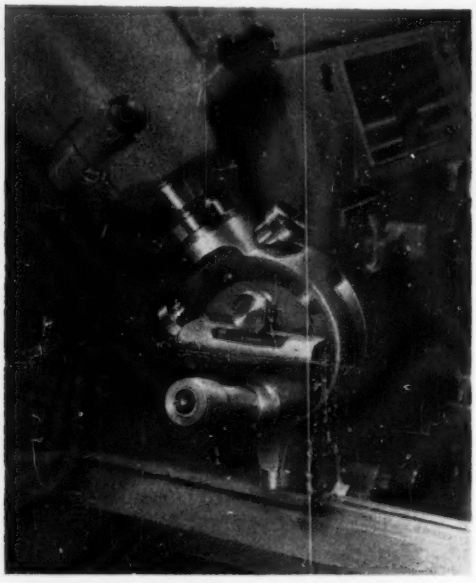
Miller Optical Goniometer

The optical goniometer here shown, has recently been introduced by Gebr. Miller G.m.b.H. Innsbruck, Austria, to facilitate accurate angular setting of swivelling spindle heads on machines, and for similar purposes.

In use, the instrument is secured to the spindle nose as shown, and is set, for angles up to 90 deg. in each direction, by means of a glass scale, which gives readings to 1 minute of arc, and is viewed through a microscope, with a magnification of 50×. With this arrangement, settings can be made to 10 sec. of arc, by estimation. Provision is also made for setting the instrument so that the

plane of the scale is accurately parallel to the swivel plane of the machine head.

Finally, the spindle head is set for angle with reference to a precision level incorporated in the instrument. Provision is made for setting the scale for zero to compensate for any error in the horizontal alignment of the machine table. Interchangeable Morse taper shanks are supplied to suit different spindle bores.



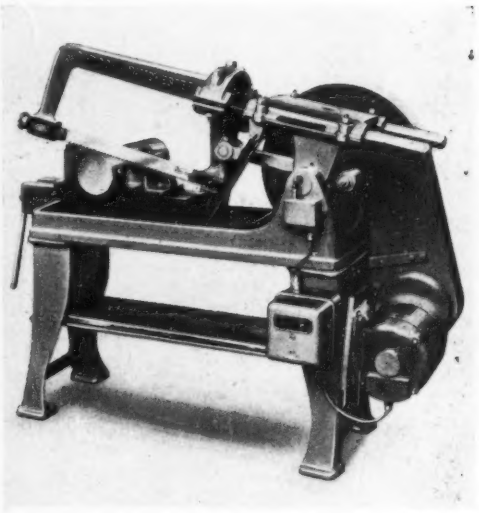
Miller optical goniometer for the accurate angular setting of swivelling heads

Gebr. Miller G.m.b.H., are represented in this country by Catmur Machine Tool Corporation, Ltd., 103 Lancaster Road, London, W.11.

Rapidor-Manchester Hacksawing Machine

The Rapidor-Manchester 6- by 6-in. capacity hacksawing machine made by Edward G. Herbert, Ltd., Atlas Works, Levenshulme, Manchester, is now available with a geared driving motor which is mounted at the rear, as shown in the figure.

From the motor, the drive is transmitted to the crankshaft by a V-belt and pulleys, and an operating speed of 100 strokes per min. is provided. A push-button starter with no-volt and overload releases, also an automatic electrically-operated stop, are fitted. Consequently, the clutch and levers previously provided for starting and stopping



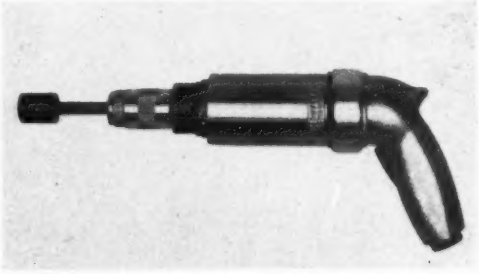
The latest Rapidor-Manchester light-duty hacksawing machine with geared motor drive

the drive are no longer required. Driving motors for operation on 3-phase supplies of 380/440 volts, and single-phase supplies of 220/240 and 230/250 volts can be supplied.

Desoutter $\frac{5}{16}$-in. Pneumatic Screwdriver

The type SH8/500, $\frac{5}{16}$-in. capacity pneumatic screwdriver and nut-runner, here shown, is the latest addition to the range made by Desoutter Bros., Ltd., The Hyde, Hendon, London, N.W.9.

Weighing 4 lb., the tool incorporates the company's SR50 motor, and has a no-load speed of 500 r.p.m. Tightening torque is controlled by means of an adjustable spring-loaded clutch. A detachable side handle is available.



Desoutter $\frac{5}{16}$-in. capacity pneumatic screwdriver

Die Casting Supplement

Control of Die Casting Quality Standards

By H. K. BARTON

The term "quality control," which originally was intended to refer specifically to statistical control of definite qualities (*i.e.*, characteristics) of a product by means of sampling techniques, has now become so hazy in its connotation that it is preferable to jettison it in favour of "statistical control," using this term to cover both the choice and application of appropriate sampling methods, and evaluation of the data thus obtained. This conception is much more limited than that for which "quality control" currently appears to stand, since there is a tendency to use the latter term to include all means of maintaining a certain level of acceptability. The acceptability of die castings, however—and probably of most manufactured products—depends, at least in part, on factors that do not well lend themselves to statistical control. This result may arise from one of two causes. Either the mode of variation is such that the information obtained by sampling is inadequate, or the factor may be one that is so vague or indeterminate that only a subjective assessment of it is possible in practice. Surface finish of die castings provides an example of the latter. In general, a matte finish giving a diffuse reflection is preferable to a bright finish (usually associated with the typical striæ of flowmarks) having a specular reflection. It would be quite easy to arrange for scanning a die casting by a light-spot, and to assess the total reflectivity of the surface with an integrating photometer, but it is difficult to see how the resulting value could be correlated with acceptability of finish. Subjective evaluation, with reference to samples having "threshold acceptability," still remains the best method of dealing with qualities that, in the last analysis, will be judged by the buyer in the same subjective manner.

CHARACTERISTICS SUSCEPTIBLE TO STATISTICAL CONTROL

Only those qualities, therefore, that are susceptible of quick, unambiguous assessment by instruments or gauges are suitable for statistical control, and weight, alloy composition, dimensional

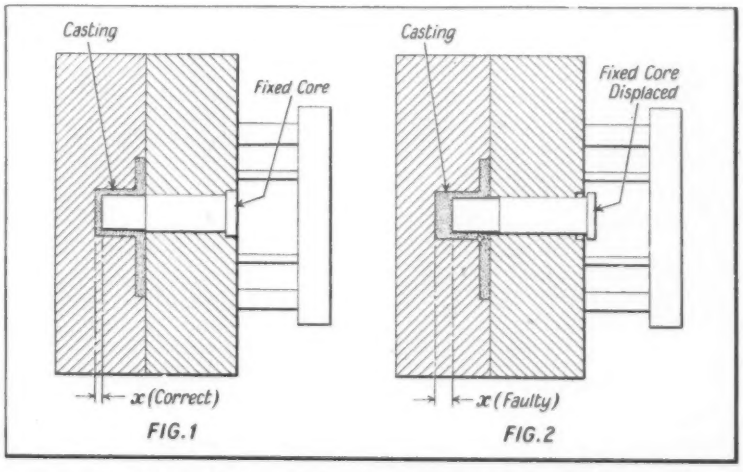


Fig. 1. With the fixed core correctly positioned, the depth of hole is such as to give the required wall thickness

Fig. 2. If a core has been forced back, the thickness x is greatly increased, but the fault may not be obvious from cursory inspection

precision, core alignment and freedom from distortion are obvious examples. The fact that a particular characteristic lends itself to precise measurement, however, does not necessarily imply that any advantage will be gained by applying sampling techniques to it. In general, sampling is only of value as a control technique when the quality concerned is one that tends to drift slowly to and from (or about) a designated level. If, by contrast, the variation is of an "either/or" nature, sampling does not give adequate process control, although it may be satisfactory for determing the acceptability of a completed batch of components.

An example is afforded by the depth of a hole formed by a fixed core (Fig. 1), which is substantially constant so long as the core does not break or become displaced. In either of these eventualities, the dimensional change is usually large, and takes place suddenly without any warning drift of the value toward one of the limits. Moreover, the dimension is usually stable at the new value, as distinct from the state of affairs which prevails with most statistically-controlled processes, where a systematic bias is superimposed upon a random variation.

It can also happen, however, that a single component suffers a dimensional change of some magnitude as a result of accidental core displacement. Such displacement is unlikely to occur in tools of recent construction, but happens occasionally in older dies where the cores are seated in the main block and are not fitted tightly. A casting may break in the die, owing to overheating, and a portion may remain lodged in the cavity. In such an event, the operator closes the tool and attempts to hook out the retained part on the end of the core, and if the latter is not firmly anchored it may be displaced backwards as indicated in Fig. 2.

What happens at the next shot depends upon the nature of the core surface. If the casting grips the core tightly, the latter will be pulled forward into the correct position at ejection. The only evidence of the displacement is then afforded by the single casting produced with the displaced core. If the core has adequate taper and a good finish, however, the displacement may not be rectified and a series of faulty castings, as in Fig. 3, is then obtained. This type of displacement has been discussed in some detail because it typifies the dimensional shifts that can occur when nominally fixed die elements are, in some manner, forced out of the casting positions. The displacements, and consequent dimensional changes associated with moving die elements, such as sliding cores, are of a different character.

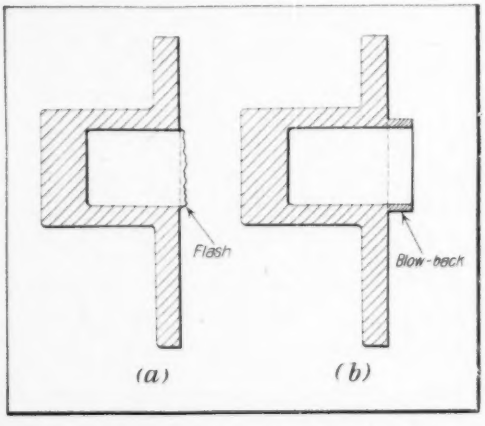


Fig. 3. If the core has a slight shoulder at the cavity intersection, the only evidence of displacement is a ragged flash at the joint as indicated in the view at a. It is desirable to provide a generous shoulder so that the "blow-back" becomes more obviously apparent

DIMENSIONAL VARIATIONS ACROSS THE PARTING PLANE

The simplest assembly of moving die parts is, of course, that formed by the two main die members, and dimensional variations across the parting plane are usually both the most noticeable and the most important. Incidence and extent of these variations are determined by a rather complex combination of operational variables, notably die and metal temperature, the nature of the die surfaces, and the frequency of lubrication. In addition, the type of die casting machine which is being used has a considerable influence on dimensional consistency across the parting. If the locking pressure is barely adequate, changes in the hydrostatic thrust exerted within the cavity may result in the dies being forced apart by a small and varying amount at the moment when filling is completed and a shock wave is generated.

The separation of the die-blocks results in the formation of a flash sheet around the castings, and this sheet may be several thousandths of an inch thick. Further, the area of the flash may easily equal or exceed that of the casting proper, and since a large part of the flash is momentarily fluid, the force tending to separate the dies can increase so much that metal is permitted to pass right across the die face. In good practice, when using well designed tools on machines of adequate capacity, metal cut-out from between the die faces seldom occurs. It is most likely to happen immediately after the die face has been lubricated.

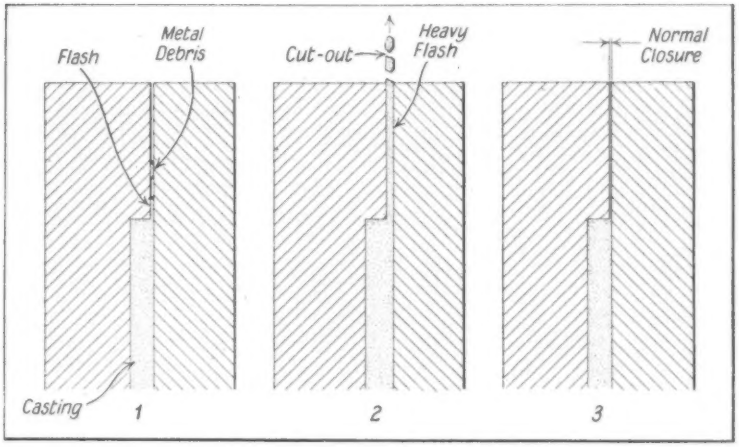


Fig. 4. Stages in the initiation and rectification of a heavy flash

To some extent, therefore, this trouble is controllable, but heavy flash can also result from the lodging of detached metal particles between the blocks, whereby complete closure is prevented. Such particles are most likely to lodge when the die faces are stepped or irregular, or are much broken up by cores or core housings adjacent to the cavity. The presence of projections and recesses of this nature makes it difficult to ensure that the die face is free from debris after the ejection of each casting. The incidence of out-of-limit castings as a result of heavy flash formation is irregular, and the condition is often self-corrected.

It is common for the dimension across the parting to be increased slightly when debris first becomes trapped, thereafter remaining fairly constant for several shots. Then, for one of a variety of reasons, a heavier fragment of metal remains on the die and closure is further impeded. A heavy flash sheet is formed, and the casting is well outside the limits. Loose particles previously left in recesses of the die, however, are caught up in the flash sheet, so that for the next shot closure is complete and the dimension across the parting reverts to normal, as indicated in Fig. 4.

PROVISION FOR HEAVY FLASH OF LIMITED AREA

Although the state of affairs described is typical of a large proportion of dies in current use, the variations can, in fact, be considerably reduced by arranging that a heavy flash is always formed, but is limited in area. This result may be achieved, for example, by restricting the irregularities of parting-line to the cavity insert alone, the main die members having plane faces as in Fig. 5. A "biscuit" of flash is then formed over the whole face of the cavity insert, terminating at the steps in the parting indicated at x in the figure. The runners and sprue should, ideally, be located within the area of the biscuit, but except with the smallest dies this is only practicable for single-cavity layouts.

Even when variation of parting-line dimensions, for the reasons discussed, are large and frequent, however, the deviations do not fall into a pattern that lends itself well to statistical control. There is not, as a rule, a progressive drift toward higher values—a drift toward lower values can only occur if the norm is shifted to allow for a certain "normal" degree of imperfect closure—and the

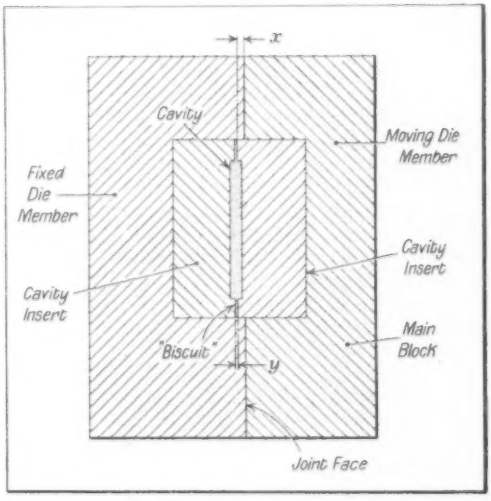


Fig. 5. By stepping the parting plane at the intersection of a cavity insert and the main block, the extent of normal flash is limited and, by providing a clearance y, the formation of a minimum flash is ensured

type of variation that does occur is attended by marked changes in the appearance of the spray of castings. A sudden increase in thickness and extent of flash sheet is sufficient indication to the operator that closure of the tool is being impeded, and he will at once take steps to correct matters without waiting for a dimensional check on the cross-parting measurement.

Correction of dimensional and other faults necessitates a survey of all operational variables, for unlike such mechanical processes as turning and pressing, die casting displays no "one-to-one" correspondence between a fault and its cause. Metal cut-out at the die parting can occur purely as a result of the tool being prevented mechanically from closing completely, but it can equally well be attributable to an increase in the temperature of the injected metal, an increased die temperature (perhaps due, in turn, to an increase in operating speed), or an increase in the pressure exerted upon the metal at injection. In a shop with a central hydraulic or compressed air system for injection, which is normally operated near the full capacity of the pumps or compressors, injection pressure can vary appreciably if there is a change in the number of machines in use.

Normally, however, it is a combination of several of these factors, rather than the predominant influence of a single factor, that is responsible for the production of off-standard components. The skill of an operator is mainly reflected in the correctness with which he is able to analyse the total situation and determine which casting variables are involved and to what extent each needs modification. Conversely, the effectiveness of a die casting machine for reliable production is directly related to the extent to which the same casting variables can be pre-set and held constant to narrow the field of personal judgment.

Nevertheless, so long as production is not completely automatic (and it is only for very small die castings required in extremely large quantities that the use of fully automatic equipment is warranted) casting quality must necessarily depend to some extent upon the judgment of the operator. For example, even where the duration of each phase of the casting cycle is predetermined, an untimed dwell period with the dies open, between cycles, is almost invariably required. A good operator maintains the dwell period at a reasonably constant value, but interruptions for such purposes as lubrication and die cleaning must inevitably occur. All such interruptions modify the thermal balance of the tool, and are therefore likely to be reflected in a change of casting quality.

SURVEY OF PRODUCT QUALITY AT THE MACHINE

Broadly, then, the difference between die casting and the more mechanical production processes lies in the fact that with the latter the operator has no means of recognizing and correcting changes in product quality as they occur, and therefore depends upon the findings of an inspector. In die casting, the operator carries out, in effect, a continuous survey of product quality. He does not

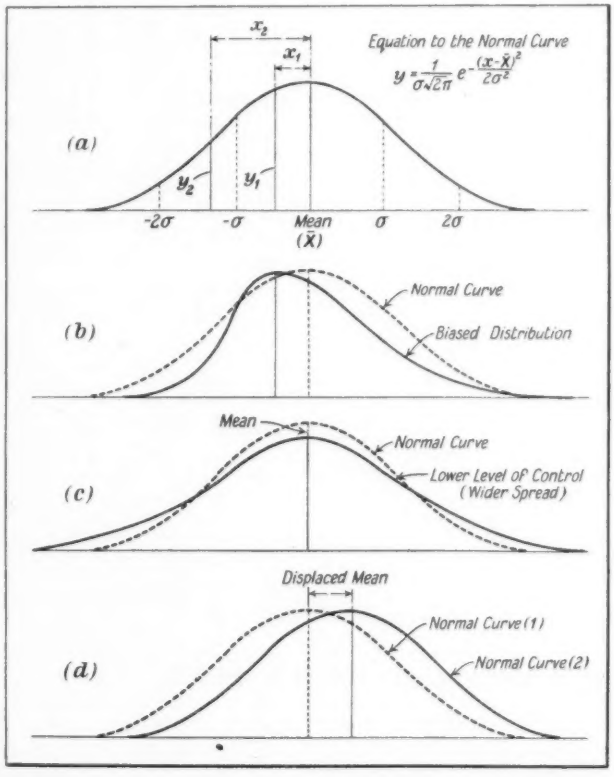


Fig. 6. The normal curve of random distribution is shown at *a*, while *b*, *c* and *d* show common modifications encountered in sampling practice

make such a survey directly, in the sense of gauging critical dimensions, or even of scanning each casting for individual imperfections, but by reason of easily-noted changes in the appearance of the spray—amount of flash, solidity of sprue, filling of overflows, and so on—and of collateral changes in the feel of the spray as it is ejected and lifted from the die, he soon learns to detect alterations in casting conditions and correlate them with specific faults.

It is not intended to imply that spot checks on castings are in any way dispensable, on the contrary, frequent inspection of components produced is essential. The point to be emphasized is rather that the averaging of values from a sample of several components provides, in the special circumstances of die casting, no advantage over a simple spot check. Sampling methods can, however, be of value when die castings are subsequently subjected to secondary operations.

THE GAUSSIAN CURVE OF RANDOM DISTRIBUTION

The characteristic of a random distribution is that the values, when plotted, form a Gaussian or "normal" curve. They tend to be evenly distributed about their average value—at the heavy ordinate marked "mean" in the diagram at *a* in Fig. 6—and tail off in each direction in a symmetrical and quite predictable manner. A curve of this general form is always obtained when a process is adequate controlled. Ascertainable causes of major variations being known and guarded against, it follows that the residual variation is due to a variety of minor factors which are just as likely to act in one direction as another. The fact that control is not being maintained is revealed by a displacement of the mean and a tendency for the curve to become unsymetrical, as at *b*, or by a lowering and spreading of the curve, as at *c*. A shift of the curve without change of form, as at *d*, may indicate that a dimension, although still held within limits of ± 0·005 in., varies from, say, 1·001 to 1·009 in. instead of from 0·996 to 1·004 in.

Although the equation of the Gaussian curve, which is given in Fig. 6, may appear rather involved, the distribution which it represents arises, in fact, whenever a series of yes-or-no choices is made at random, as in the tossing of a penny, for instance.

Displacement of the curve in the manner indicated at *d* in Fig. 6 may result, for example, from the incorrect re-setting of a cutting tool after it has been ground. The effect of such faulty setting is to change the average value of a particular dimension without altering the range over which it varies.

A distortion of the type depicted at *b* might be encountered in connection with a metal powder compacting operation. Numerous hardly distinguishable factors determine the actual mass powder fed into the tool at each cycle of the press. Normally, these factors operate in a random manner and the mean value is substantially constant. Occasionally, however, a bias may be detected, which might be attributable, for instance, to a change in atmospheric humidity.

Because of the simplicity of its assumptions, statistical control is most applicable to production operations that are themselves simple. The more complex a single operation, the less likely is it that the results can be adequately represented as the outcome of a series of random choices. This statement applies even if the complexity can be analysed into a set of discrete elements each having its particular sources of variation. In die casting, however, there is a complete operation that cannot be broken down in any way, and a group of production variables the effects of which are mutually interactive. Moreover, these effects are usually of intermittent and unheralded occurrence, and are often so transient in their incidence as to offer no basis for control by periodic sampling.

Because die casting, although carried out in a single operation, is a most complex process, the measures needed to maintain a state of control equivalent to that obtainable with simpler "statistically controlled" processes are themselves necessarily complex. It is, indeed, only within quite recent years that it has become possible to maintain a really effective control over the process, since the use of cycle-timing devices which can be pre-set is essential if consistent finish, density, and dimensional accuracy are to be maintained, this last term being taken to include planarity and freedom from distortion generally.

The comments that follow refer specifically to the die casting of zinc-base alloys, primarily because a fuller control is possible on gooseneck machines than is at present practicable with cold-chamber equipment, but also in order to avoid the need for constant reservations and qualifications as regards points on which practice in casting the light alloys differs from that applicable to zinc alloys. It will, however, be obvious that many of the factors discussed apply equally to both alloy groups.

As has already been noted, a specific modification of casting quality cannot be referred solely to a single variable in the process. In particular, the effects of changes in die temperature, metal temperature, injection pressure and operating speed are inextricably inter-related. Together, these factors determine the changes in heat input

and heat removal, and it is to the balance of the latter—the thermal balance of the die—that physical characteristics such as density and surface finish, and mechanical factors such as dimensional accuracy and freedom from distortion, are directly attributable. An increase of speed, in other words, may call for a reduction in the metal temperature, or even in the injection pressure, to maintain the general characteristics of the castings at the level that prevailed under the previous conditions.

DIE TEMPERATURE AS A BASIS FOR QUALITY MAINTENANCE

For practical purposes, however, it is necessary to establish, arbitrarily, some fixed point from which to work outwards, and although, to some extent, a low die temperature can be offset by a high temperature of metal injection, and vice versa it is desirable to take die temperature as the fixed basis. Zinc-base die castings are particularly sensitive to changes in the temperature of the cavity surface. Below about 200 deg. C., the surface of the component loses its characteristic bloom—first locally and then generally—and begins to show flowmarks and other faults of structure. Above about 240 deg. C., on the other hand, the matte surface of the casting begins to display imperfections, due to the trapping of air between the skin and the heated cavity wall.

As the die temperature is further raised, other types of blemish appear. Delayed cooling results in excessive contraction of heavy sections of the component, the surfaces of which may sink away from the cavity walls. Although the margin of 40 or 50 deg. C. may seem generous enough—and would be ample if it were possible to hold the whole cavity surface at the same temperature—in practice there is always a temperature gradient across the cavity, which, for a large component may well amount to 25 or 30 deg. C. Consequently, the effective range within which variations can occur is halved.

MINIMIZING THE THERMAL GRADIENT

The more marked the thermal gradient, the more restricted are the casting conditions within which commercially acceptable components are produced. Dies in which steep gradients are established are therefore termed "critical," and their intolerance of even small departures from particular speeds of operation, or of changes in injection temperature, often results in a high scrap percentage. It is not, of course, a matter of chance whether a particular tool is critical or tolerant. This characteristic depends partly on the ratio between the mass of the casting and the mass of the die-blocks, but mainly upon the location of the sprue, runner and overflows in relation to the cavity. Cavity orientation, moreover, is particularly important when there is an appreciable variation of wall thickness between one part of the casting and another.

Water-cooling is also utilized to reduce the thermal gradient, but its effects are too localized and severe, and it can only be used effectively in conjunction with a balanced lay-out. Where thermal flow is high—in medium diameter cores and other areas where overheating occurs—water-cooling is essential for fast operation, but it is seldom satisfactory to attempt to employ water-cooling for extracting heat locally from a hot spot in a cavity. The cooling of the cavity should be of a general character, the water channels being kept well away from the cavity surface. If this precaution is not taken, small changes in operating speed may cause large alterations in the local die temperature, due to the considerable difference between the mean temperature at the cavity (about 230 deg. F.) and the water temperature of, say, 80 deg. C.

Water is not, in fact, a very good heat extraction medium for die casting purposes, and experimental work with high boiling-point fluids such as Arochlor has already shown the value of a transfer fluid that is circulated at a temperature differing as little as possible from that required at the cavity surface. Use of such fluids, however, would require a drastic reappraisal of present-day cooling techniques, since the latter are based on the existence of a steep temperature gradient between cavity surface and cooling channel. To control cavity temperature when using a coolant which is only a few degrees below that temperature necessitates both an accelerated flow rate and a very large transfer surface. Indeed, the area of surface from which heat is being extracted must be little less than the actual cavity area. Ideally, therefore, the cavity insert should have the form of a shell of substantially even thickness, through which heat is transferred with high efficiency from the metal to the cooling medium.

Even when using conventional drilled cooling channels (much more closely spaced, and nearer to the cavity, than is usual) the improved efficiency of high temperature coolants is very evident. For full value to be obtained from the method, however, it is clear that more elaborately channelled cavity inserts will be needed. The two methods that immediately come to mind in this connection are electroforming and precision casting. Both these methods would enable cavity inserts to be produced, which, although intricately recessed, were adequately supported.

The greatest potential value of high-temperature coolants lies in the ease with which they can be used, when necessary, to transfer heat to, instead of from, the die. In this way, a very close control of temperature can be maintained, and it has already been shown that a die can thus be heated much more efficiently than by running-off a series of sub-standard components merely in order to bring the tool to the required operating temperature.

The heating element is, of course, arranged to cut in automatically when the temperature of the outflowing coolant falls, to maintain the die temperature during interruptions in production. Provided that the flow of coolant is maintained, there can be no drastic fall in die temperature in any circumstances.

When these newer cooling techniques become generally accepted, they will go far to minimize the effect of what is, at present, the most disrupting factor in the control of timed-cycle machines. This factor is the operator-controlled dwell period between cycles, during which the casting is removed from the die. The actual period is not likely to vary greatly from cycle to cycle, but there are intermittent requirements, such as lubrication and cleaning of the die face, which now result in appreciable fall in die temperature. It is during such interruptions that an alternative heat input is needed.

Given an operating cycle in which the duration of the various phases has been correctly determined, and an effective heat-transfer system, very high production speeds can be achieved. In order to prevent the production of long series of faulty castings, therefore, it is essential to inspect the components coming from each machine at frequent intervals. In order that the intervals between checks may be short, the time spent on each check should be kept to a minimum, and to this end a satisfactory relationship must be determined between the general surveillance of casting quality carried out by the operator, and the testing of the parts in a few critical respects by the inspector.

SEGREGATION OF SUB-STANDARD CASTINGS AT THE MACHINE

Maintenance of acceptable quality standards is still often impeded by a lack of co-operation on the part of the operator, who may allow manifestly sub-standard castings to become mixed with the bulk of sound parts. In some shops, indeed, no provision is made for any other course. It is true that in modern die casting foundries it is no longer good practice to throw obviously unsound components straight back into the melting pot, as was once quite common, but it is still desirable to segregate castings which are evidently faulty.

The operator should therefore be provided with a separate pan in which he can place any spray of castings that is clearly sub-standard, for whatever reason. This practice offers advantages in two respects. Not only does it ensure that the initially faulty castings will not slip through inspection at later stages, but it quickly makes obvious any unusual increase in the quantity of sub-standard components produced. It is, of course, necessary that the operator shall have a clear idea both of the quality standard required (which varies greatly from job to job) and of the specific faults that are to be expected.

Only those imperfections that are immediately obvious can be used as criteria by the operator. Characteristics such as internal soundness and dimensional precision must be left for spot-checking by the floor inspector. Nevertheless, external evidence of unsoundness or out-of-limit dimensions, such as surface sinks or unduly heavy flash, should justify the operator in rejecting the components in question. Apart from these points, the operator should primarily be concerned with the general quality of the cast surface, the absence of distortion, and the completeness of the component. This last point may seem too obvious, but it can easily happen with an intricate casting having thin ribs or slender studs, as in Fig. 7, that a portion of a component may remain wedged in the cavity during many succeeding casting cycles unless the operator is on the look-out for such an occurrence.

Once an operator has become conversant with a particular tool it is not an onerous task for him to keep a continuous check on casting quality, since he knows, in advance, what faults are likely to

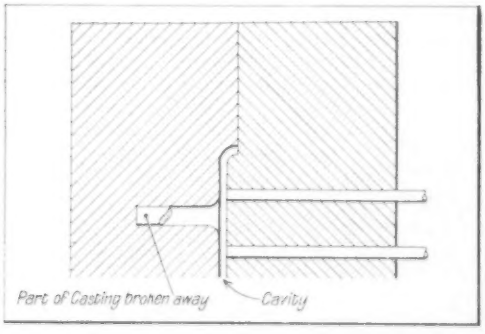


Fig. 7. The end of a slender stud may break away and, with a large and complex casting, may remain in the die for many cycles without the fault being detected

result from specific changes in casting conditions. At the beginning of a shift, therefore, he pays particular attention to the surface finish and watches for short-runs in thin sections. When the die is running steadily he will note any jerk or hesitation as the tool opens, or as the casting is ejected, for these slight irregularities may be indicative of such incipient faults as galling and distortion, and, in addition, may afford the first warning of impending mechanical failure. After the application of a die lubricant, it is particularly important to scan the first one or two sprays, since the presence of vapour in the cavity can result in various casting faults. Frequently, in fact, it is more satisfactory to discard the first spray cast after lubricating the die even if there are no obvious imperfections, for lubricant may nevertheless have become entrained in the injected metal with a consequent loss of structural strength.

DIE LUBRICATION AND EJECTOR DESIGN

In any event, lubrication of the ejectors from the front of the moving die member should be avoided as far as possible. For most tools, it is preferable (some types of collet dies are exceptions) to spray lubricant from the rear of the die-blocks. Effectiveness of lubrication depends, to a considerable extent, upon the form of the ejector and its housing, and many tools that are otherwise of excellent design are sadly lacking in this respect.

In many shops, all dies are still fitted with unrelieved ejectors of the type seen in Fig. 8, the plain drilled housing being either counterbored to

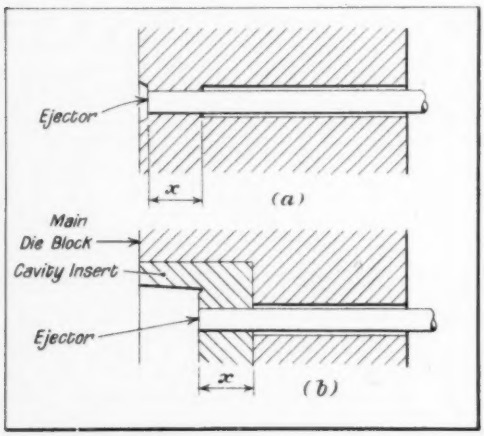


Fig. 8. If counterbored or stepped ejector-housings and plain ground ejectors are employed, it is difficult to maintain effective lubrication

within an inch or so of the face (view *a*), or increased in diameter in the main block only, as indicated at *b*. For large dies, the ejectors are sometimes nitrided, but in smaller tools unhardened silver steel ejectors are still commonly employed. The construction shown, although it has the merit of being simple and cheap, has few operational advantages to commend it.

Of its several disadvantages, the first and greatest is that, at each ejection stroke, the whole working length of the ejector is thrust through the unrelieved portion x of the housing. The wear on this length is therefore severe, and frequent lubrication is necessary to prevent seizure, especially in new tools where the ejectors have little clearance in the housings. Lubricant applied from the front tends to be scraped off and left at the cavity face when the ejector retracts, and it is not until the housing becomes slightly bell-mouthed that any quantity of lubricant can be carried into it. Lubrication from the rear is a little more effective, but tar and carbon tend to collect at the shoulder in the housing.

It is therefore preferable, in general, to provide the relieved type of ejector shown in Fig. 9, the details of the design differing to some extent with the diameter. For the smaller sizes and shorter strokes, the ejector may be the same diameter at x and z, the intermediate diameter being some 0·010 to 0·015 in. less. The housing in the die block is of one diameter throughout and normally provides a clearance of 0·0015 in. upwards, according to diameter, for the working end of the ejector. The length a of the ejector tip should not be less than $3x$, but it is an advantage if a is less than the working stroke.

The length of the relieved portion b is not critical, but although there may appear to be good reasons for standardizing it for each length of ejector, this course may lead to difficulties in practice. Plain ejectors can be cut to any length required, but if relieved ejectors are shortened, part of the working length a is lost. For this reason it is desirable to grind the relief only after the total length and the desired length a have been determined, and the length b can then be varied as necessary.

The length a plus b should be somewhat more than the engaged length of the ejector. In other words, part of the relieved portion should be visible at the rear of the die-block when the latter is in casting position. This exposed portion of the relief facilitates lubrication. The unrelieved portion y of the ejector should, however, enter the housing for some little distance as the ejector stroke is completed. This point is important, for it will be seen that the diameter z scavenges the

rear portion of the housing, and lubricant is therefore carried forward, at each stroke, to the hot forward end of the housing, by the relieved portion of the ejector. Actual friction between ejector and housing is, of course, very much less than with an unrelieved design. On the return stroke of the ejector, more lubricant is transferred to the housing, so that there is little chance of galling when the unrelieved portion *a* is drawn back into the casting position. Consequently, there is no need for frequent lubrication of the overheated tips of the ejectors.

The pumping action of the ejector upon lubricant sprayed on from the rear is much greater when the diameter *z* is appreciable larger than *x*. Shouldered (or composite) ejectors are therefore to be preferred for large dies and where service conditions are particularly severe. When such an ejector is used, the housing is counterbored as seen in the lower view in Fig. 9. It might be thought that the relief on the ejector shank is less important with this arrangement owing to the improved pumping action. In fact, however, the relief is all the more necessary since, for a given diametral clearance, the space around the shank of the ejector is always much greater than the space around the working end. As a result, oil tends to be forced backwards along the shank of an unrelieved ejector pin, and carbonization products build up within the housing.

This recommended form of ejector has been described at some length because, although ejectors are a minor and routine element in die construction, their failure has a constant and, cumulatively, highly important effect upon down-time and, in consequence, upon machine utilization. This effect is all the more marked when a machine is operated on a semi-automatic cycle, for it is less easy to detect incipient ejector failure when the ejector stroke is a phase in a timed cycle, than when ejection is initiated by the operator. The outcome is, of course, that in order to obviate unforeseen breakdowns the operator tends to overlubricate and, quite often, to use release agents—"die slicks"—in unjustifiable quantity. This practice, in turn, results in a high scrap rate or—even worse—in structurally weak components passing inspection.

Satisfactory ejector design and construction is therefore a very real factor in product control, since, by facilitating lubrication from the rear of the tool, it reduces the likelihood of lubricant being trapped in the casting or spoiling the surface. Moreover, it is relatively easy, when the whole array of ejectors is sprayed from the rear, to actuate the air valve intermittently (with a pegged disc or similar arrangement) so that the lubricant is automatically renewed after every eight or 10 shots, or with whatever frequency is found necessary. For operational reasons it is less easy, and distinctly less efficient, to lubricate the forward ends of the ejectors automatically.

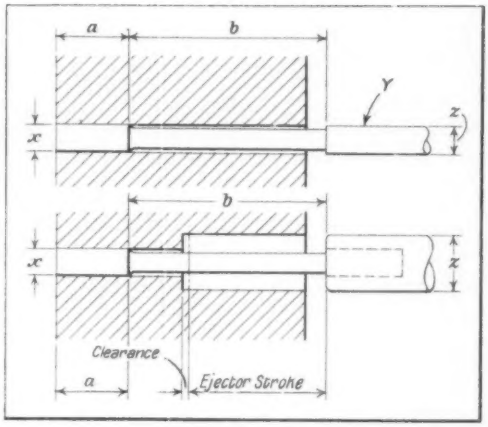


Fig. 9. Shouldered ejectors in plain housings can be lubricated from the rear, since the pumping action of the ejector (especially if it is of composite construction, as below) forces the lubricant forward towards the hot end of the housings

With the die lubrication thus included in the operating cycle, there need be few interruptions of the steady production rate. Removal of metal debris—loose particles of flash—from the die face, however, may still involve occasional stops. With die temperature closely controlled, however, heavy flashing should not occur provided that there is no sudden increase in injection temperature. Since the holding furnace is invariably controlled thermostatically, changes in injection temperature are almost always due to the additions of large volumes of fresh metal to the melt at long intervals, rather than small quantities more frequently. Feeding with molten metal permits closer control than feeding with broken ingot, but unbroken ingots can be fed gradually down into the melting pots of large machines, at a rate proportional to consumption. With such an arrangement, sudden temperature variations are entirely avoided.

Even this precaution, however, cannot completely exclude the possibility of loose flash particles remaining on the die face to impede closure. Flash fragments are always likely to remain in venting channels and adjacent to sliding die elements. Their incidence can nevertheless be greatly reduced by deliberately inducing the forma-

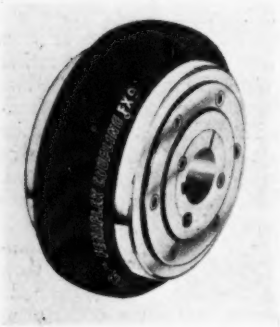
tion of a relatively heavy flash immediately around the cavities in the manner described earlier. With multi-cavity dies, the formation of a "biscuit" of flash has the further advantage of holding all the components in correct alignment for gang-trimming. Casting with permanently clean die faces will, perhaps, never be entirely achieved, but it can be very nearly approached in modern machines, with their rigid frames and heavy locking tonnages, by controlling casting variables in the manner here outlined and—a necessary proviso—by constructing dies having a strength and rigidity commensurate with those of the machines in which they will operate.

Only in this manner can the innate precision and invariability of the process be brought to full realization, and quality standards maintained by the continuous control of casting variables. On the shop floor, the first step is to make it easy for operators to segregate obviously unsatisfactory castings as soon as they leave the dies. Where this course is followed, the extent of the wastage becomes so obvious that there is a real incentive to modify the tool or the operating procedure. No such impact is produced when bins of scrap are passed from the inspection tables or trimming department to the re-melt furnaces, since faulty castings from several tools are likely to be mixed.

Fenaflex Flexible Couplings

An example from the Fenaflex range of flexible couplings recently introduced by J. H. Fenner & Co., Ltd., Marfleet, Hull, is shown in the figure.

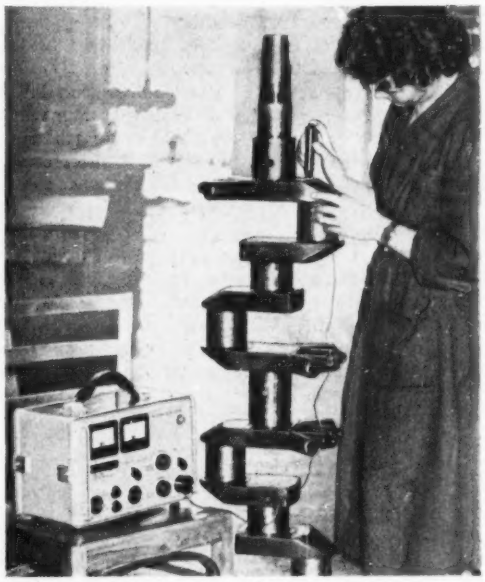
Comprising, essentially, a rubber tyre gripped by metal end pieces, the coupling will compensate for end float, and angular and parallel misalignment between a pair of shafts. It is made in 8 sizes, the largest of which will transmit 20 h.p. per 100 r.p.m. Taper-Lock bushes are fitted which permit easy mounting on and removal from shafts. Very long life is claimed for the tyre, which is of split design so that it can be readily changed, without the need for removing the entire coupling from the shafts.



One of the new Fenaflex flexible couplings

Hungarian Portable Equipment for Examining the Microstructures of Metals

A portable instrument, known as the Intactor Microport, has been developed in Hungary to provide a means of rapidly and inexpensively examining the microstructures of both large and small components, at a number of positions if required, to determine the quality of the materials, and suitability of heat treatment. The equipment consists of an etching and electrolytic polishing pencil, seen being applied to a crankshaft in the accompanying illustration, and a microscope for examining the prepared surface, both these units being plugged into a control box seen in the figure. Changeover from etching to polishing is effected by means of a switch, and the intensity of the processes is regulated by two knobs.



Preparing a crankshaft for examination of the microstructure, using the Intactor Microport

It is stated that preparation of the surface at the selected point occupies less than two minutes, and that successful application of the technique requires little skill. If a series of reference specimens is prepared for comparison purposes, the equipment can readily be employed by inspectors and operators on the shop floor. Provision is made for mounting a small camera on the microscope unit.

New Range of Peco Die Casting Machines

The Projectile & Engineering Co., Ltd., Thessaly Road, Battersea, London, S.W.8, who began the design and construction of pressure die casting and injection moulding machines shortly after the end of the last war, are now introducing a new range of die casting machines, which incorporates the experience gained during the intervening period. These machines, which will be sold by Peco Machinery Sales (Westminster), Ltd., 28 Victoria Street, London, S.W.1, are designed to apply die locking pressures of 300, 500, and 750 tons, and one of the largest size, of which several have already been supplied to die casting companies in this country and on the Continent, is seen in the general view, Fig. 1.

Of basically conventional design, the machine incorporates a hydraulically-operated toggle-type locking mechanism, and nitrogen-filled high-pressure accumulator cylinders provide for injection. The machine shown is arranged for cold-chamber operation on aluminium and magnesium alloys and brass, but it can be supplied with a hot-chamber conversion unit for zinc alloys, if required. The robust one-piece steel base is weld-fabricated from plate, and is of such a thickness that the longitudinal centre-line through the platens is at a convenient working height. At the left-hand end of the machine there is the hydraulic tank, also weld-fabricated from steel plate, which forms a separate unit and carries the 35-h.p. pump-driving motor, two Vickers Detroit pumps arranged in tandem, and the main hydraulic control valves.

The die-locking toggle mechanism, of which a close-up view, from the rear of the machine, is given in Fig. 2, is of fully-balanced design and is fitted with hardened and ground knuckle-joint pins, operating in similarly treated sleeves in the toggle links. All the links in the toggle mechanism are of massive proportions, and those at the forward end are connected to a back plate, seen at the left in Fig. 2, through which force is applied to the moving platen. This back-plate is machined from a steel casting, and it is of approximately the same dimensions as the platens. At each corner, the back-plate, and the moving platen, are cut away and are fitted with semi-circular phosphor-bronze shoes whereby they are guided on the tie bars.

In Fig. 3, which was also taken from the rear of the machine, this back-plate is seen at the right, and on its front face it carries a large-diameter screw of buttress form. This screw is engaged by a nut in a housing on the rear face of the moving platen, to the left in Fig. 3, and provides for the adjustment of the moving platen to accommodate a die of different thickness. The nut is in the form of a ring with worm-wheel teeth on its periphery, and is turned, for adjustment, by means of a worm. A push button-controlled electric motor, seen in the background, drives the nut through a small

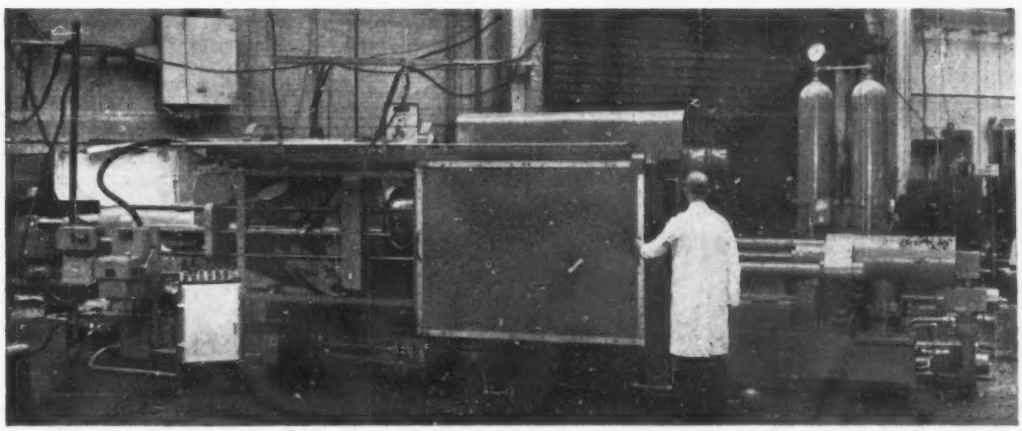


Fig. 1. General view of the Peco 750-ton capacity, cold-chamber, pressure die casting machine from the new range which is now being produced by the Projectile & Engineering Co., Ltd.

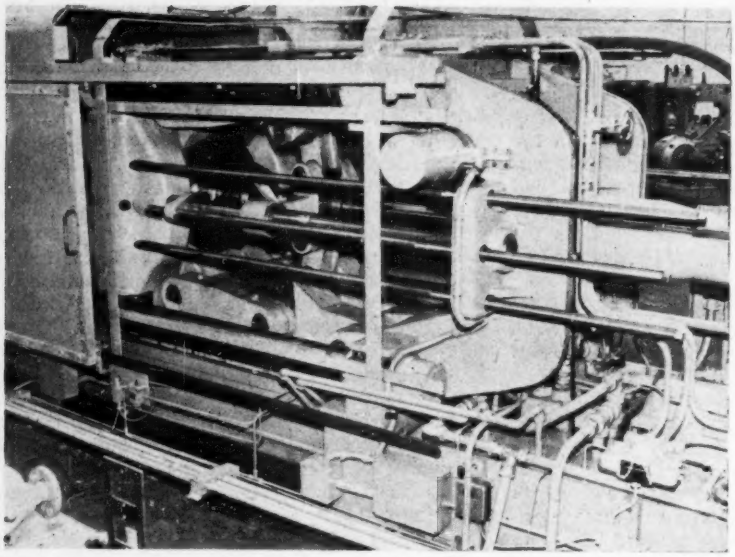


Fig. 2. A view showing the toggle-type locking arrangements, push-rod ejectors, and the guard at the rear of the 750-ton Peco machine

reduction gearbox, and provision is also made for turning it manually. Dies having maximum and minimum thicknesses of 35 and 19 in. can be employed on the machine.

Another view, from the front, showing the fixed and moving platens, is shown in Fig. 4, where the high-tensile steel tie bars are also seen. The bars are of 6⅝ in. diameter, increased to 6⅞ in. at the ends to form flanges, and the two upper bars can be retracted, when necessary, to permit the installation of large dies. For this purpose, the locking nuts and collars are removed and the tie bars are secured to the moving platen with the aid of clamps provided. The platen is then moved back, pulling the bars with it, and this procedure can be repeated if the bars require to be retracted through a greater distance than a single platen stroke.

Like the back-plate, the fixed and moving platens are machined from steel castings, and the spaces between the tie bars measure 37⅜ in. horizontally, by 40⅜ in. vertically, the dimensions of the platens being 53 by 57 in. Both the moving platen and the back-plate are provided with bearing shoes on their lower edges, which are supported on hard-chromium plated slideways on the base. The box-shaped structure formed by the moving platen and the back-plate provides a good bearing length and the weight of the moving die member is taken on the base rather than on the tie bars. Adjustments for the stroke length, which may range from 21 in. up to a maximum of 32 in., can be made by means of a screw incorporated in the housing for the die closing cylinder.

Ejection of castings from the die may be effected by means of a central hydraulic ejector cylinder, seen at the centre of the back-plate in Fig. 2. Alternatively, this cylinder may be employed for pulling a central core

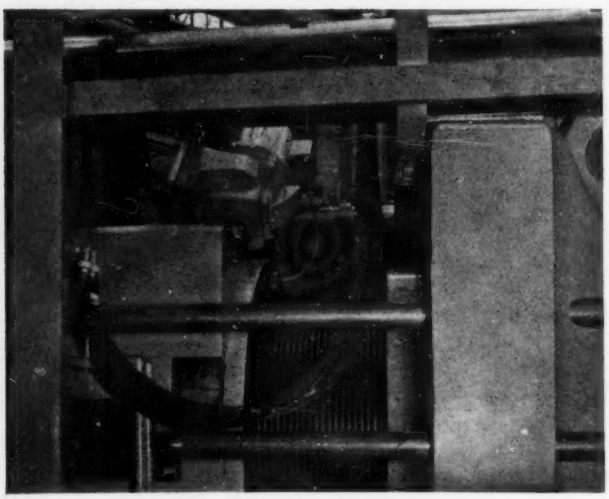


Fig. 3. Adjustments to the position of the moving platen, to cater for different die thicknesses from 19 to 35 in., are made by means of a motor driving nut on a large buttress-screw

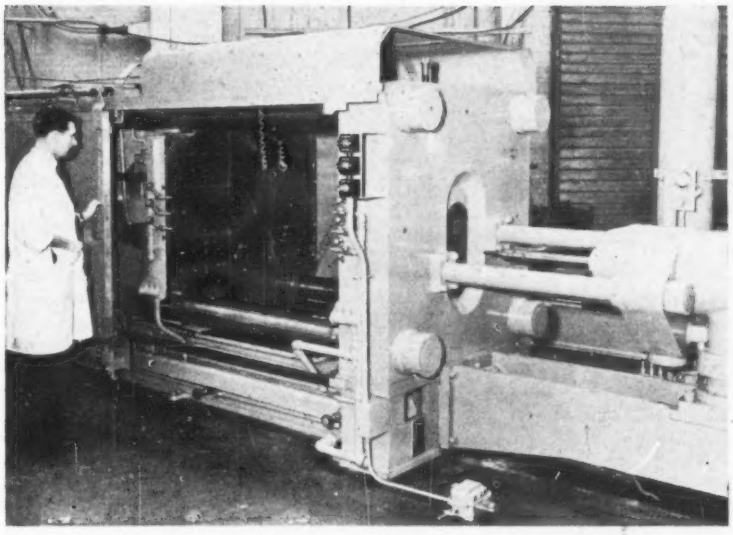


Fig. 4. A view of the injection end of the 750-ton machine showing the 6½-in. diameter tie bars, and the platens which measure 53 by 57 in.

where a casting with a deep cavity requires a long projection in the moving half of the die. When this arrangement is adopted, the casting may be separately ejected with the aid of two push-rods, centrally located one on each side of the machine, which are aligned with projections on a substantial ejector plate at the rear of the moving platen. The maximum stroke of the ejection cylinder is 12 in., and the total movement that can be transmitted by the push-rods is 4 in. Ejector mechanisms which are so far displaced from the centre that they cannot be operated by the central plate, may be actuated by two additional push-rods which are located on each side of the machine, as may be seen in Fig. 2.

INJECTION MECHANISM

The injection mechanism is carried on the end of an outrigger bracket secured to the end face of the machine base, and is seen in the close-up view, Fig. 5. A large-diameter hydraulic cylinder supports the plunger cylinder, and provides for raising the latter when the injection position is to be changed from 10 in. below the platen centre, to the central position in which it is shown. When this change is to be made, bolts holding a thick C-washer, in the form of a slotted, flanged tube, are removed, together with the tube, and the bolts are then replaced to secure the cylinder mounting flange in the new position. A length of spacer tube is also removed from the supply line to the ejector cylinder, no flexible pipes or joints being employed.

Since the injector cylinder has a bore diameter of 11 in., and the hydraulic system operates at a line pressure of 1,000 lb. per sq. in., the total force that can be exerted during injection is of the order ot 95,000 lb. The effective plunger stroke is 17 in., and the maximum shot, in aluminium, is 26 lb. with a 4½-in. diameter plunger. Under these

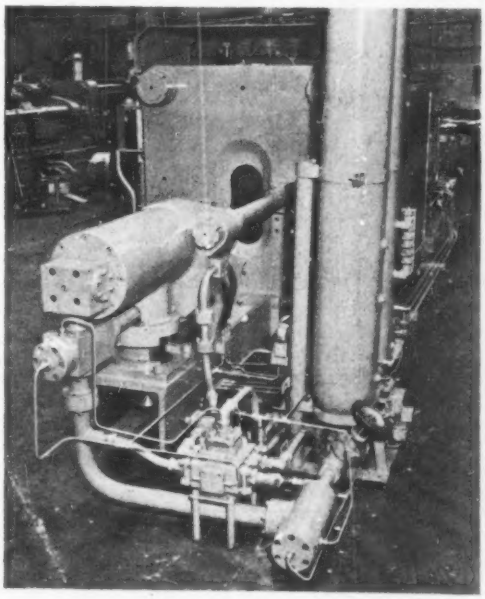


Fig. 5. The nitrogen-filled accumulator cylinder and hydraulic control valves are located near the injection cylinder, which can be positioned level with the platen centre or 10 in. beneath it

conditions, castings can be produced with a maximum projected area of slightly more than 280 sq. in. The distance that the injector plunger protrudes beyond the face of the fixed platen may be varied between 4¼ and 8¼ in. to suit die plates of various thicknesses. Both the injection sleeve and plunger, which are of nitrided, heat-resisting steel, can be easily removed when the dies are being changed.

As may be seen from Fig. 5, the hydraulic valves and accumulator cylinders which are employed for the injection cycle are located close to the plunger-operating cylinder. Injection takes place in three phases, and a sectional view showing the cylinder and some of the associated valves is given in Fig. 6. It should be noted that the arrangement here shown is somewhat different from that illustrated in Fig. 5, but the principle of operation is the same. Initially, after the injection cycle has been started by pressing a push-button, the piston in the plunger-operating cylinder *A* moves forward comparatively slowly to ensure that metal in the sleeve does not splash out through the pouring aperture, the rate of movement being controlled by a restrictor valve which determines the rate of delivery from the pump and accumulator.

When the end of the injection plunger has passed the aperture, the restrictor valve is opened. Movement of the piston to the left, due to the delivery of oil from the accumulator and pump to the right-hand end of the cylinder *A*, causes oil to be displaced from the left-hand end, and transferred, by way of the check valve *C* and the pilot-operated valve *D*, to the right-hand end, where it supplements the external supply. Since the area of the piston rod in the cylinder *A* is one-third that of the piston, it follows that oil is transferred from the left- to the right-hand ends of the cylinder at twice the rate of the external delivery. Consequently, the speed of piston movement is three times as great as would be obtained with the external delivery alone, and a very rapid movement of the injection plunger is obtained.

As soon as the cavity has been filled, the plunger movement is arrested, and the build-up of pressure in the system causes the unloader valve *B* to open. Consequently, pressure on the oil in the left-hand-end of the cylinder is relieved, and the force exerted on the plunger corresponds to the full line pressure of 1,000 lb. per sq. in. multiplied by the area of the piston in the cylinder *A*. Under these conditions, with a plunger diameter of 2¾ in., for example, the pressure exerted on the metal is nearly 24,000 lb. per sq. in. This high pressure is maintained during the solidification period, the duration of which is controlled automatically by an electric timer in the control cabinet, and dense castings of high strength are thus obtained. The change from high-speed movement of the plunger to high pressure, it is stated, is virtually instantaneous, cavitation in the cylinder *A* having been eliminated by the arrangement of the valves. Since there is no time-lag, no pressure-drop occurs between the two phases of the cycle.

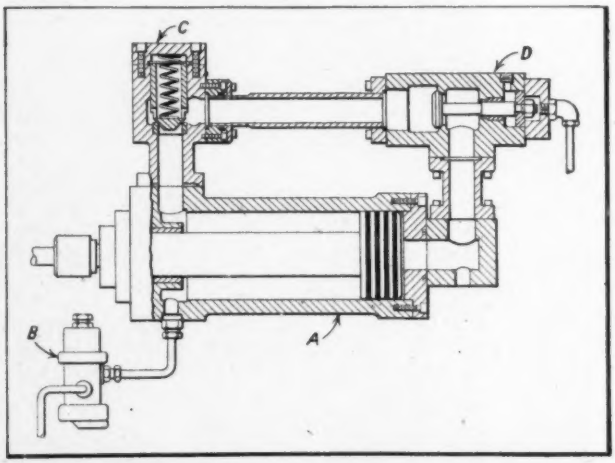


Fig. 6. Diagram showing the arrangement of the valves employed in conjunction with the injection cylinder to provide a slow initial movement followed by high-speed injection

CORE OPERATION

Provision is made for the use of two separate sets of hydraulically-operated cores, each set consisting of one or more cores, which can be arranged to advance or retract automatically at the appropriate points in the cycle. This equipment is additional to the central ejection cylinder which, as explained above, can be employed for operating centrally-placed cores in the direction normal to the parting plane of the die. The moving platen can also be stopped, automatically, at any point during the closing or opening movement, while hydraulically-operated cores are advanced or retracted. In the same way, the moving platen may be stopped for the insertion of loose cores, or for the advance or retraction of other manually-operated parts of the die.

For stopping the platen there is a series of micro-switches enclosed by a

protective drum which projects horizontally from the rear of the machine, as seen near the upper centre in Fig. 2. The drum covers a shaft which is supported in bearings in a bracket secured to the side of the steel casting wherein the rear ends of the tie bars are anchored. This shaft carries a large-diameter roller-chain sprocket on the end nearest to the machine, and beneath the sprocket there is a long bar, attached at the left-hand end to a bracket on the centre link of the toggle mechanism, and supported at the right-hand end in a hole in the projection which carries the rear ends of the ejector push-rods.

The bar has a longitudinal groove at the top, and in this groove is fixed a length of roller chain which meshes with the pinion and functions as a rack. As the platen is moved forward or back, and the shaft is turned by the sprocket, cams mounted on it actuate the micro-switches. These switches are connected through the control unit, which is described later, to the relays and solenoids whereby the supply of hydraulic oil to the platen-closing cylinder and other units is regulated. Considerable flexibity is thus afforded for the operation, in a semi-automatic cycle, of the various elements of the machine in any desired order.

SAFETY CONSIDERATIONS

The die space between the platens is guarded on each side of the machine by a sliding sheet metal panel which the operator is seen holding in Fig. 4. This guard has a framework of angle-section material and is supported at the lower edge on grooved rollers which move on a rail. At the top it is guided by rollers which engage a length of channel-section material attached to the fixed machine members at each end. The guard is moved by a long-stroke air cylinder of small bore, and the air supply line is fitted with a relief valve which limits the total force applied to move the guard. The guard is automatic in operation and its movement is initiated by pressure on a push-button on the fixed platen.

This button is inoperative except when the foot-switch seen on the floor at the right in Fig. 4, is depressed, so that the operator must stand clear of the platens during the closing movement. When the guard reaches the end of its travel, it operates a micro-switch connected to the control unit, to initiate the semi-automatic cycle. The rear guard may be operated in a similar manner, so that if an operator must be stationed at the rear of the machine for handling loose cores or inserts or removing castings, he is protected. In addition, there are guard panels extending across the top of the machine.

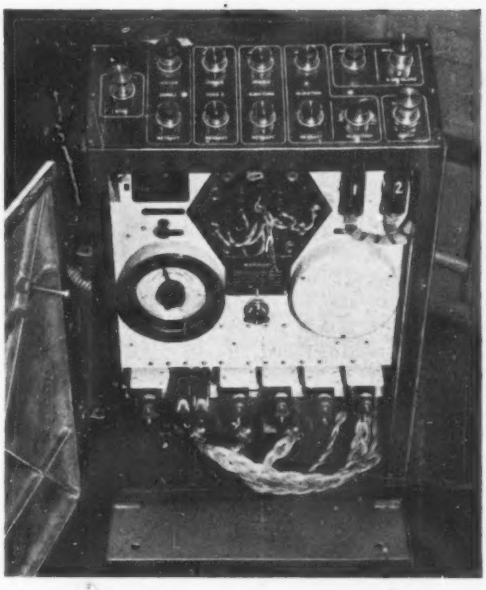


Fig. 7. The controls for the machine movements, centralized on this desk, include a switch for the selection of semi-automatic or manual cycles

The semi-automatic cycle of the machine is controlled electrically by means of equipment installed in a centralized unit, as seen at the left in Fig. 1. A close-up view of this unit, with the door opened to show the internal arrangements, is given in Fig. 7, where the electric process timer for the control of the solidification period is seen at the left. At the centre of the unit, just beneath the sloping top surface carrying the push-buttons, there is a number of electrical sockets of special design, arranged in a circle. The sockets are connected together in two sets, in series, but when a plug is inserted into any socket, this connection is broken. The circuit is completed once more by the closing of a micro-switch at the completion of the movement of some mechanical unit on the machine.

For example, to arrange for a core to be advanced immediately after the die has been closed, the micro-switch, which is closed by the completion of the die movement, is connected to one of the sockets. A plug connected to the solenoid valve for controlling the appropriate core-operating cylinder is inserted in the next socket, and as soon as the die has closed the next circuit will be made and the movement of the core initiated. If no plug has been inserted in a socket, the circuit remains complete up to the next socket

or up to the position at which selection of the injection cycle must be made manually.

The sockets are arranged in a circle corresponding to a clock face, and all those between the 12 and 6 o'clock positions are employed for machine movements which must be completed before the beginning of the injection cycle. Sockets in the remaining positions are employed for the return movements, after solidification is complete. A switch on the control desk provides for selection of semi-automatic cycle or manual control, and when it is in the latter position, all the push-buttons on the top of the unit are energized. These buttons can then be employed to operate the various machine movements during setting-up or trial runs. Apart from the guard-close and cycle start button on the fixed platen of the machine, there is a second button which can be employed to open the guard at the end of the cycle, and a third which is labelled "reverse cycle". Depression of this third button at any point in the cycle initiates the operations of all the equipment connected to the sockets after the 6 o'clock position, so that all the cores are retracted, and the dies are opened automatically in an emergency.

British Productivity Council

Sir Miles Thomas, D.F.C., chairman of Monsanto Chemicals, Ltd., has been elected chairman of the British Productivity Council, 21 Tothill Street, London, S.W.1, for 1959, and Mr. W. J. Carron, president of the Amalgamated Engineering Union, deputy chairman. Mr. Carron, it may be mentioned, is a member of the Machine Tools Advisory Council to the Board of Trade and a member of the Engineering Advisory Council. In addition, he holds other important offices on trade union committees.

In announcing these appointments during a recent B.P.C. meeting, the present chairman, Mr. Lewis T. Wright, general secretary of the Amalgamated Weavers Association, reported on the work of the B.P.C. since it was established in November, 1952, for the purpose of educating the public in the need for raising productivity and for promoting an appreciation of the means by which this result might be achieved. He referred to the growth in the activities—and numbers—of local productivity committees and associations, of which there were now no fewer than 106, and pointed out that all of them were joint bodies including employers and trade unionists supported by representatives from technical colleges and professional institutions. The organizations were run on a voluntary basis but were supported and assisted by eight regional officers. Almost all committees had established some means of promoting the exchange of ideas in their areas and circuit schemes were often operated for this purpose. Certain specific productivity techniques, Mr. Wright continued, had been selected by the B.P.C. for individual attention. The first was work study, and more recently variety reduction, quality control, and costing had received similar consideration.

In the field of technical education, local productivity committees had provided centres for meetings between industrialists and technical college teachers, and at the Spring Bank County secondary school in Derbyshire, teaching on productivity subjects had been introduced into the final-year curriculum.

The headquarters of the B.P.C. were concerned with publicity and publications, which were selling at the rate of 40,000 per year; visual aids, including films; special projects; and technical education.

At the end of his speech, Mr. Wright introduced Mr. R. W. Mann, managing director of Victor Products (Wallsend), Ltd., who spoke on the problems of introducing "productivity" to an industrial area such as Tyneside, where he is chairman of the local productivity committee. Subsequently, Mr. Cyril Taylor, divisional organizer A.E.U. and vice-chairman of Coventry L.P.A., spoke on aspects of the work of the Coventry Productivity Association.

Finally, Sir Miles Thomas paid tribute to the work of Mr. Wright during 1958. He went on to emphasize the need for raising productivity by every available means, and announced that within a few months the number of full-time regional officers would be increased from eight to 12. Sir Miles also stressed the importance of relations between employers and employed. Admittedly such relations were not directly the concern of the B.P.C., but failures in this sphere could nullify all other means of raising productivity.

After a discussion period, the meeting concluded with the showing of the B.P.C. film entitled "Variety Reduction."

METHOD OF REDUCING LINEAR BEARING FRICTION. For applications where extreme sensitivity is required, Thompson Industrial, Inc., Manhasset, N.Y., U.S.A., it is reported, have applied the principle of "intrareciprocation" in connection with their linear ball bushes. Provision is made for reciprocating either the shaft or the bearing through a short stroke with a fairly high frequency, for example by means of an electromagnetic coil or a small servo-type motor. In this way "stiction" is avoided. The conditions selected are such that the other component is unaffected by the "mechanical ball actuation."

Elliott Machine Tool Demonstration

A full range of machine tools and production equipment made by the B. Elliott Group was demonstrated recently at the showrooms of the parent company, B. Elliott (Machinery) Ltd., Victoria Works, Willesden, London, N.W.10.

New machines on view included the Elliott-Victoria hydraulic surface grinder shown in Fig. 1. The 8- by 18-in. T-slotted work table of this machine has a longitudinal travel of 19 in. on vee and flat slideways, and a cross movement of 9 in. is provided for the saddle, which is guided in V-ways on the bed. A vertical adjustment of 15 in., by hand only, is provided for the wheel-head slide, on V-ways which are covered by telescopic guards, and the maximum distance obtainable between the centre-line of the spindle and the table is 17½ in. A selector mechanism is incorporated in the handwheel which enables vertical wheelhead movements of 0·05 and 0·005 in. per rev. to be obtained for coarse and fine adjustments.

Steplessly-variable table speeds available range from 2 to 75 ft. per min., and cross movement can

Fig. 1. Elliott-Victoria 8- by 18-in. hydraulic surface grinder

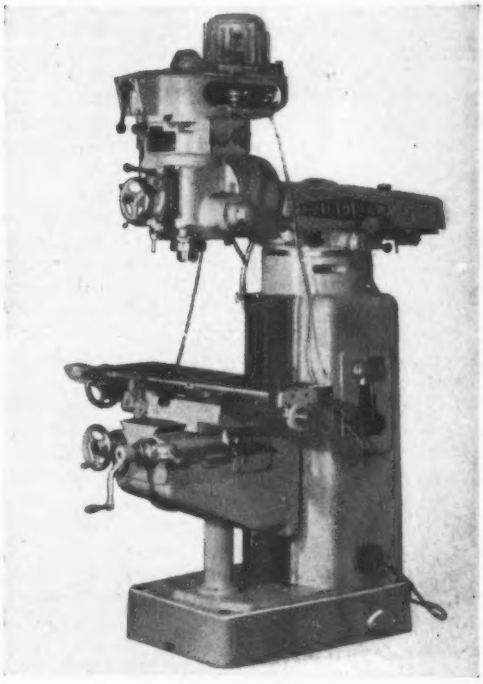


Fig. 2. Elliott-Victoria type TV2 turret milling machine

be applied to the saddle either intermittently in steps from 0 to ¾ in., or continuously, at speeds from 0 to 25 ft. per min., to enable "criss-cross" grinding to be performed. Separate knob-operated hydraulic valves, incorporated in the saddle, provide for adjusting the table speed and the intermittent and continuous cross traverse movements. The saddle is automatically reversed at the end of each stroke by means of adjustable stops. Depression of a plunger on the saddle, while grinding is in progress, causes the table to be moved to the extreme end of its travel in either direction and then stopped, so that the work may be inspected. When this plunger is released, the table is automatically traversed in the opposite direction, and then reciprocated in the normal manner.

Pressure fluid is delivered to the hydraulic

cylinders for the longitudinal and cross travels through separate systems, which are supplied by a dual helical gear pump, driven by a 1-h.p. motor. This arrangement ensures that movement of the saddle is unaffected by any pressure fluctuations in the hydraulic system for the table travel.

Grinding wheels up to 10 in. diameter can be mounted on the spindle, which is driven at speeds of 2,140 and 2,850 r.p.m., through a V-belt and stepped pulleys, from a 1½-h.p. motor. The spindle runs in an oil bath, and the nose end is mounted in an Accuramatic 3-piece bearing, which is pre-loaded by the wedging action of the oil film, and the rear end in anti-friction bearings.

A dust collecting unit and a wheelhead-mounted diamond dressing attachment, as shown, can be supplied. If required, equipment can be provided for delivering coolant through the grinding wheel, so that it is applied to the work in mist form directly at the point of cutting. The machine is also available without the hydraulic equipment for operating the table and saddle.

In Fig. 2 is shown the recently-introduced Elliott-Victoria type TV2 turret milling machine, which was available for demonstration. Of similar design to that employed in the company's Omnimis vertical and horizontal milling machine, the cutter head can be turned through angles up to 90 deg. on each side of the vertical position, and is carried by a box-section overarm, which can slide on dovetail guides in a swivel base on top of the column. Maximum and minimum distances of 28 and 6 in. are obtainable between the centre line of the spindle and the column face.

Ten spindle speeds from 80 to 2,700 r.p.m. are available, the drive being taken from a 1½-h.p. motor, through a belt and stepped pulleys, and back gearing. The spindle, which is bored to take a No. 30 taper shank, has an axial travel of 5 in., and three power feeds, namely 0·0015, 0·003, and 0·006 in. per rev., are provided. The 36- by 10½-in. T-slotted table has a longitudinal travel of 22-in., and a cross-movement of 12 in. by hand, and the vertical adjustment of the knee is 16 in. Provision is made for accurate table setting, longitudinally and transversely, by means of measuring bars and dial indicators. A maximum distance of 18¾ in. can be obtained between the spindle nose and the top surface of the table.

The machine is also available with a different, non-swivellling, cutter head and a 1¼-h.p. motor drive which gives 10 spindle speeds from 100 to 2,600 r.p.m. A spindle travel of 3½ in., and a single feed of 0·002 in. per rev. are then provided. Alternatively, a cylindrical overarm can be supplied to take this cutter head, and maximum and minimum distances of 19 and 6 in. are then obtainable between the centre line of the spindle and the column face.

The latest Elliott-Progress 1¼-in. capacity pillar drilling machine, known as the type 3E, is illustrated in Fig. 3. It incorporates a newly-developed 6-speed gear box, which is driven by a link-type V-belt from a 1¼-h.p. motor. The 12 spindle speeds thus provided range from 60 to 1,125 r.p.m. Two feeds, namely, 0·0025 and 0·0045 in. per rev., are obtainable, selection being made by a knurled knob on the side of the spindle head. Bored to take a No. 3 Morse taper shank, the ball-bearing mounted spindle has an axial travel of 6 in., and an adjustable stop is fitted to facilitate drilling holes to predetermined depths, with hand or power feed. A 17½-in. diameter or a 22- by 18-in. T-slotted work table can be provided, as required, and vertical adjustment on the 4¾-in. diameter columns is obtained by rack and pinion. The maximum distance from the spindle nose to the table is 23½ in., and to the base, 41½ in.

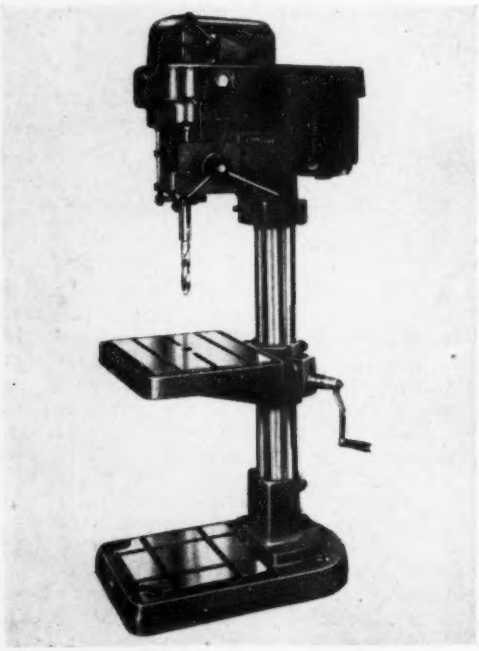


Fig. 3. The latest, type 3E, Elliott-Progress 1¼-in. capacity pillar drilling machine

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EXPORTS OF ALL TYPES OF MACHINERY, other than electric, during October were valued at £44,369,927.

The 1958 Sir Alfred Herbert Paper

The seventh Sir Alfred Herbert paper of the Institution of Production Engineers was presented by Sir Cecil Weir, K.C.M.G., K.B.E., M.C., D.L., a past president of the Institution and chairman of the British Tabulating Machine Co., Ltd., at the Royal Institution, London, W.1, on Thursday, December 11. Sir Cecil, who was formerly head of the United Kingdom Delegation to the High Authority of the European Coal and Steel Community, took as his subject "The European Common Market, the Free Trade Area, and the Production Engineer." The chairman on this occasion was the Rt. Hon. The Earl of Halsbury, president of the Institution, who, before he introduced Sir Cecil to the large audience, made a presentation to Dr. R. Barrell, D.Sc., A.R.C.S., D.I.C., F.Inst.P., Superintendent of the Metrology Division, National Physical Laboratory, the author of the 1957 Sir Alfred Herbert Paper (see MACHINERY, 91/1112—8/11/57).

In his paper, Sir Cecil Weir drew attention to the historical significance of the development of the European Coal and Steel Community and, subsequently, the European Common Market, and stressed the fact that nothing like them had ever been achieved before. The Community, he pointed out, was established by France, Federal Germany, Italy, Holland, Belgium and Luxembourg, and these countries had a total population of nearly 160 million. This population was approximately equal to that of the U.S.A., and was nearly as great as that of the U.S.S.R. Headquarters were established in Luxembourg, and, by treaty, the Community had been charged with the duty of creating a common market for coal and steel, in place of the more restricted national markets that existed previously.

The speaker then reviewed in detail just what such a common market entailed. Briefly, it implied the elimination of all customs duties, quotas, subsidies, currency restrictions, and transport and other discriminations that affected the free flow of trade between the member countries. Moreover, it provided for reasonable mobility of labour, especially skilled labour, between member states, and the equalization of those elements, social and otherwise, which influenced the cost of production. In carrying out its task, the Community was directed to stimulate smoother and vigorous economic expansion, promote rational distribution of production, achieve a higher level of productivity, increase the total employment afforded, by expansion of output, give greater security of employment, and improve living and working standards.

EUROPEAN COMMON MARKET

Sir Cecil reviewed the institutions that were founded for the administration and other duties associated with the Community, and which served as patterns for those of two companion communities that have recently been created, namely, the European Atomic Energy Community (Euratom) and the European Economic Community or the European Common Market, as it is more popularly known. The speaker emphasized that it was to the European Economic Community that production engineers, and those controlling business and industry generally, in the United Kingdom, must pay close attention. The aim of the Common Market was to abolish by stages, over a relatively short period of 12 to 15 years, customs duties and other restrictions and discriminations that affected trade between the six member countries, and to harmonize their tariffs on goods coming into the Common Market area from elsewhere. There was to be a common policy for agriculture, co-ordination of social policies, including these that related to social security, accident and health insurance, and trade union rights. A European Investment Bank was to be established, with an initial capital equivalent to $1,000 million, to assist development and to help in modernization and conversion. The Common Market was to be associated with the overseas territories of the member countries, and a special fund for the development of these territories was to be established with an initial capital that was equal to $500 million.

The speaker then went on to give some statistics relating to the Common Market, and pointed out that the six member countries would have an estimated total population of nearly 175 million in 1970. Their gross national product in 1955 was estimated at £45,000 million, and it was considered that in 1970 this would have risen to some £70,000 million. In 1956, exports of the six countries exceeded £7,000 million, including those to member countries which, under the Common Market, would become internal trade. For comparison, the gross national product of the U.K. in 1956 was about £17,000 million, and in that year our exports (excluding re-exports) had a value of appreciably more than £3,000 million, of which

exports exceeding £500 million in value were consigned to the six countries of the Common Market.

It was clear, Sir Cecil continued, that the development of the Common Market was of considerable significance for Great Britain, and it was important that we should not be excluded, but associated with it by means of a Free Trade Area which would follow a tariff policy, for industrial products, that was similar to that operating in the Common Market.

THE PRESENT POSITION

The Government had reached a crucial stage in its negotiations, and it was not enough merely to co-operate on tariff reductions with the Common Market countries and those of O.E.E.C. Many difficult and delicate matters would have to be agreed and included in a treaty associating the other free countries of Europe with the "Six". The problems associated with such a treaty must be resolved with all possible speed if we were not to be faced with a period of dangerous uncertainty, during which decisions of long-term significance might be taken by manufacturers and governments in the countries concerned, and, in some instances, great political and economic policies initiated with regard to the diversion of trade and the direction of new industrial investment.

A treaty of alliance with the Coal and Steel Community had already been made, and it was hoped that we should successfully create a Free Trade Area, associated with the Common Market. If this Area was created, it would bring a new and immediate challenge to British industry and to production engineers. We should progress swiftly towards free trade in industrial products, which would not only allow us to enter Continental markets on equal terms with Continental producers, but would also allow those producers the same facilities in our domestic markets. If we did not succeed in creating a Free Trade Area, the challenge would be all the greater and of a less agreeable character.

In any event, the speaker stated, we should have to make sure that our methods of production matched or were better than those of our most capable competitors, that our rate of productivity continued to advance, and that our adoption of aids to increased output was not restricted either by the fears of trade unions or the reluctance of management.

In this connection, the production engineer would find a task appropriate to his profession, suited to his training, and vital to his country. It should be his duty to study continuously every new method of production that was being tried out or in use in other industrial communities, as well as in his own, and to apply the best of them in his own factory or workshop.

In conclusion, Sir Cecil indicated that, generally, in engineering, which embraced a large proportion of British industry, in chemical manufacture, and in the production of some, but not all, consumer goods, we had nothing to fear from equal competition, and much to gain, provided—and only provided—we made every effort to obtain fresh business. To do that, we had to ensure that our methods were up to date, and that our production costs were low, familiarize ourselves with the markets that we had to enter, sustain the campaigns on which we embarked, study the habits, practices and design requirements of each customer country, and remember, that in a competitive struggle, only the best would win.

DISCUSSION

From the discussion that followed, it was apparent that considerable interest had been stimulated by the paper, and that some of those present regarded the possibility of a Common Market with certain misgivings. The discussion was opened by Mr. R. H. S. Turner, vice-chairman of council, Institution of Production Engineers, who emphasized that the Common Market would establish, within 20 miles of this country, an economic power that was greater than the U.S.S.R., and second only to the U.S.A. It should be remembered, the speaker stated, that at present many Continental manufacturers could sell successfully in this country, in spite of import duties, and, in similar circumstances, many of our manufacturers were able to sell in Continental markets. The future of our industry would depend more than ever on close collaboration between production engineers, designers and the commercial branches of business, and it might be necessary for this country to adopt Continental standards and the metric system if we were to compete successfully for foreign markets. In his opinion, there were a number of advantages for us if we were associated with the Common Market, but we should not lose sight of the fact that 40 per cent of our current exports went to the Commonwealth countries and only 14 per cent to those of the Common Market.

In his contribution to the discussion, Sir Thomas Hutton, former director of the British Productivity Council, stated that in the present delicate stage of negotiations between the Common Market countries and the 11 others that would participate in a Free Trade area, only France was causing any difficulties. The other Common Market countries were unwilling to put pressure on France for fear

that the complete project might thereby be jeopardized. Sir Thomas pointed out that many potential member countries would be faced with greater problems in connection with the establishment of a Free Trade Area, than would the United Kingdom. In his opinion, efficient manufacturers would not find it difficult to survive in a Free Trade Area, but the difficulties would undoubtedly be greater in some industries than they were in others. He felt, however, that the establishment of the Common Market would present us with a much more serious problem, due to the mutual trading arrangements within the group. In conclusion, he made a plea for the extension of the principles of production engineering on a wider scale, and considered that all branches of British industry could benefit by the adoption of such principles.

INFLUENCE OF MARKET SIZE

Mr. A. A. Jacobsen, of the Motor Accessories Division, S. Smith & Son, drew attention to the disparity between the potential home market of 50-million people in this country, and of 164-million of the Common Market countries. He thought that this larger home market would give advantages to the Common Market manufacturers since they could produce in larger quantities and therefore employ more efficient methods. In this connection, he pointed out that a large home market was often cited as one of the factors that contributed to the high standard of productivity in the U.S.A.

Mr. W. J. Evans, of J. Evans & Son (Portsmouth), Ltd., expressed the opinion that the long term political implications of the Common Market might be more serious for us than the economic consequences. Mr. B. H. Dyson felt that higher production management in this country had not taken enough responsibility in connection with the Government decisions on the Free Trade Area, in contrast with the strong influence of manufacturers in the Common Market countries.

In his reply to the discussion, Sir Cecil Weir agreed that British manufacturers must try to ensure that they were more efficient than their competitors. With regard to the influence of market size, Sir Cecil pointed out that if the Free Trade Area were established, British manufacturers would have a potential market of 250 million. In any event, efficiency would be the secret of success, and, in his experience, the majority of British companies were as efficient as their opposite numbers on the Continent.

In closing the discussion, Lord Halsbury drew attention to the sense of dedication in all those connected with the Common Market and Free Trade Area plans, and asked Mr. B. E. Stokes, chairman of the Editorial Committee, Institution of Production Engineers, to propose the vote of thanks to Sir Cecil Weir. This speaker said that it was refreshing to be reminded of the objects and ramifications of the Common Market and Free Trade Area plans in such simple terms, and he felt that many of the aims of these schemes could be applied with advantage to industry in any country.

Coming Events

INSTITUTION OF PRODUCTION ENGINEERS. *Wolverhampton Section.* January 7, at 7.15 p.m., at the Town Hall, Wednesbury: lecture on "Current Profile Milling and High-speed Surface Broaching Techniques," by A. R. Hambridge.

JUNIOR INSTITUTION OF ENGINEERS. January 9, at 7 p.m., at the Institution, Pepys House, 14 Rochester Row, Westminster, London, S.W.1; paper on "Engineering Tolerances," by R. J. Herbert.

INSTITUTION OF MECHANICAL ENGINEERS. January 9, at 6 p.m., at the Institution, 1 Birdcage Walk, Westminster, London, S.W.1. Ordinary meeting in conjunction with the Applied Mechanics Group: paper on "Stress and Deformation Studies for Sandwich Rolling Hard Metals," by R. R. Arnold and P. W. Whitton.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS. January 9, at 6.15 p.m., at the Mining Institute, Newcastle-upon-Tyne: lecture on "High Torque Merchant Ship Gearing," by J. R. G. Braddyll, B.Sc., and M. C. Oldham.

Industrial Notes

AN AUCTION SALE OF MACHINE TOOLS and miscellaneous stores from the Technical Stores Depot, Old Dalby, will be held in Melton Mowbray on January 14. The auctioneers will be Shouler & Son (Dept. N), 1 Norman Street, Melton Mowbray, Leics.

ENDECOTTS (FILTERS), LTD., in view of increasing demand for their products, have acquired larger premises at Lombard Road, London, S.W.19, to which they will move on January 5. Both offices and works will be accommodated at the new address, where, it is stated, there is more than twice the space available in the buildings now occupied.

Corrections

In MACHINERY 93/1378—10/12/58 it was stated that the mechanical type bar automatics made by Butterworth British Automatic Machine Tool Co., Ltd., range in capacity from $\frac{7}{8}$ to $2\frac{1}{2}$ in. bar diameter. This should have read "$\frac{7}{8}$ to $1\frac{1}{4}$ in." Hydraulic type Butterworth machines have bar capacities from $1\frac{5}{8}$ in. to $2\frac{1}{2}$ in.

In the article concerned with a 4,000-ton forging press installed by the Northern Aluminium Co., Ltd., which appeared in MACHINERY, 93/1347—10/12/58, it was inadvertently stated that the manipulator, made by Head Wrightson & Co., Ltd., has a capacity of 1.500 lb. This should, of course, have been 1,500 lb.

News of the Industry

Leicester

A. A. JONES & SHIPMAN, LTD., Braunstone, are actively engaged in the production of their various types and sizes of plain, universal and production cylindrical grinding machines, some of which are fitted with Taylor-Hobson automatic sizing equipment. Hydraulic surface grinding machines of 18- by 6- and 27- by 10-in. capacities, and tool and cutter grinding machines, are also in progress. Good results are reported from the recent exhibitions in France and Italy at which the firm's machines were displayed. There is a steady demand for Micromatic honing machines, including the No. 150 hand or automatic horizontal type, of 12-in. stroke, for 1½-in. bores, which was described in MACHINERY, 93/1240—26/11/58. Recent additions to plant include a Tarex chucking automatic, Jones-Shipman cylindrical and surface grinders and a Ramo semi-automatic lathe, for which the company are sole selling agents in this country.

In the small tools department, business is well maintained in drill sleeves and sockets, lathe centres, centre drills, tool-holders, machine vices, milling machine arbors and Impero universal lathe tool equipment. Our attention was drawn to the recently-introduced Lamalock surfacing plate for facilitating precision surface grinding, which is arranged to fit on to all sizes of magnetic chucks, of either the permanent magnet or electric types. We hope to describe this equipment more fully in due course.

S. RUSSELL & SONS, LTD., have a varied programme of Hydrofeed sawing machines in hand, also automatic saw sharpeners. In the works, we noted a batch of 12½-in. automatic sawing machines equipped with patent bar stillages, and special Hydrofeed machines fitted with duplex saw blades. Our attention was also drawn to the firm's recently-developed 2-in. capacity automatic cutting-off machine for non-ferrous metals, alloys and plastics, which is provided with a bar rack and conveyor equipment. We hope to make further reference to this machine at a later date. Export orders have been received recently from Australia, South Africa and Canada, among other countries. The foundry section reports a steady demand for spheroidal-graphite, alloy-iron and grey-iron castings, and conditions in the general engineering and steel fabrication departments are similar.

FREDK. POLLARD & CO., LTD., have the usual run of standard single- and multi-spindle bench- and column-type, vertical drilling machines, 21- and 28-in. heavy-duty upright drilling machines, and radial drilling machines in progress, for both home and overseas customers. In addition, we may note special horizontal and vertical production-type machines provided with tooling equipment and fixtures for large output, for the motor car and other industries. The recent extensions to the fitting shop have now been completed and brought into use.

WADKIN, LTD., have recently noted some improvement in the demand for their wide range of woodworking

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At a recent luncheon of the Council of the Gauge and Tool Makers' Association, Standbrook House, Old Bond Street, London, W.1, the retiring president, Mr. F. W. Halliwell, C.B.E., who held this office from 1947 to 1958, was presented by the new president, Sir Stanley Harley, B.Sc., with a silver salver, "as a token of affection and esteem," from his colleagues on the Council. The salver bears the signatures of all the Council members

machinery, from both home and overseas customers. In the non-ferrous metal working machinery section, orders are in hand for high-speed routing machines, heavy-duty radial arm routers, high-speed vertical milling machines and cutting-off saws of various types. Interesting development work is in progress in this department to which we hope to refer more fully at a later date. New canteens have recently been completed and brought into use at these works.

ADCOCK & SHIPLEY, LTD., have a good volume of work in progress, including plain and universal horizontal and vertical milling machines, unit-head machines, radial drilling machines and universal machine tools. Among the special machines for the motor car industry we noted two unit-head piston drilling and reaming machines, centring and facing machines and deep-hole drilling machines, also No. 0 and No. 1 automatic-cycle milling machines with air-hydraulic feed systems, and continuous milling machines. Our attention was drawn to a batch of twin-column rotary transfer drilling, reaming, and tapping machines, for use in the production of refrigerator parts. We hope in due course to make further reference to the firm's recently-introduced No. 1 automatic-cycle milling machine. Other activities include the production of lens grinding machines. We may note recent export orders from Australia, Canada, South Africa, U.S.A., Hungary, Holland and South America. A Herbert Preoptive lathe has been added to the plant.

TAYLOR, TAYLOR & HOBSON, LTD. (one of Rank Precision Industries, Ltd., companies) are steadily employed with the production of Talysurf surface roughness measuring instruments, Talyrond roundness measuring instruments, pantograph milling and die-sinking machines, engraving and routing machines, Javelin etchers, cutter grinding machines, micro-alignment telescopes, auto-collimators and Talymin gauges. Much interesting development work is now in progress in relation to various instruments and machines to which we hope to make further reference in the future.

H. B.

MACHINERY'S CIRCULATION

as certified by Chartered Accountants

33 KING WILLIAM STREET,
LONDON, E.C.4.
20th NOVEMBER, 1958

The Directors,
The Machinery Publishing Co., Ltd.,
National House, 21 West Street,
Brighton, 1.

Gentlemen,

We have examined the books and records of The Machinery Publishing Co., Ltd., relating to the distribution of fifty-two weekly issues of "Machinery" for the year ended 1st October, 1958, and we certify that during the period selected by you as normal trading, viz., the thirteen weeks ended 24th September, 1958, the average distribution per week was 11,382 (eleven thousand, three hundred and eighty-two) copies, of which 10,107 copies were paid for.

Yours faithfully,
(Sgd.) THOMSON McLINTOCK & CO

The latest audited figures for MACHINERY'S Circulation for the three months ended September, 1958, are shown above

Electro Mechanical Engineers, Ltd.

Facilities for the production of ring-type self-damping springs, bottle moulds and precision parts are provided by Electro Mechanical Engineers, Ltd., who have moved from their works at 800 Old Kent Road, London, S.E.15, to a newly-built factory at Powerscroft Road, Footscray, Sidcup, Kent. Established 13 years ago, with eight employees, this company has gradually enlarged the labour force and increased turnover as a result of securing contracts for the supply of ring springs and other products to Government departments, the aircraft industry, and firms engaged in work associated with the utilization of nuclear energy.

Ring springs, it may be noted, originated in Germany, where they were used in the armament industry for recoil mechanisms of guns and for railway buffers. Since the end of the second world war, these springs have become better known in the United Kingdom and are now being used for

non-military purposes. Ring springs, and the methods employed in their manufacture, were described in MACHINERY, 85/869—22/10/54. Briefly, a ring spring comprises a stack of inner and outer rings which have mating tapered surfaces machined to a specified angle (usually 14 deg.) in relation to the axis of the assembly. The application of axial pressure causes the outer rings to expand and the inner rings to contract so that the overall length of the stack is reduced. Energy is absorbed while the rings are stressed and released as they regain their normal shape. The use of ring springs for absorbing shock, it is claimed, obviates violent release of energy during recoil.

In Fig. 1, ring springs of three sizes, made by Electro Mechanical Engineers, Ltd., are shown. Such rings are tested in the works, to ascertain their compression characteristics, on a Probat spring testing machine which gives dial readings up to 4,500 lb. Several ring spring assemblies of 6 in. diameter were recently produced for use in the suspension systems of road vehicles designed to carry heavy loads. Other springs have been made for the foundations of steam hammers, to prevent transmission of vibration through the ground. It is claimed that ring springs incorporated in the steering gear of ships will effectively absorb shock transmitted by rudders in heavy seas. Such springs can also be employed as shock absorbers in connection with wire ropes for hoisting industrial lifts and colliery cages, and drawbars for towing agricultural machinery and trailers. Other applications include the tensioning of rolls or jaws in machinery for breaking coal and other minerals, to guard against damage in the event of uncrushable material being encountered, and the control of movement of portions of a structure under the influence of heat. For example, the roof of an arch furnace may be fitted with a ring spring in a yoke, which is provided with an adjusting nut, as a means of applying variable pressure depending on the temperature of the furnace. It has also been suggested that ring springs could be applied to the suspension systems of small road vehicles, to provide self-damping independent springing.

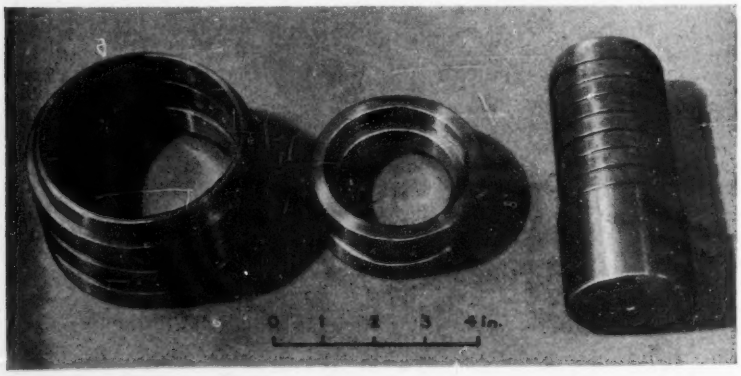

Fig. 1. Three sizes of ring springs produced by Electro Mechanical Engineers, Ltd.

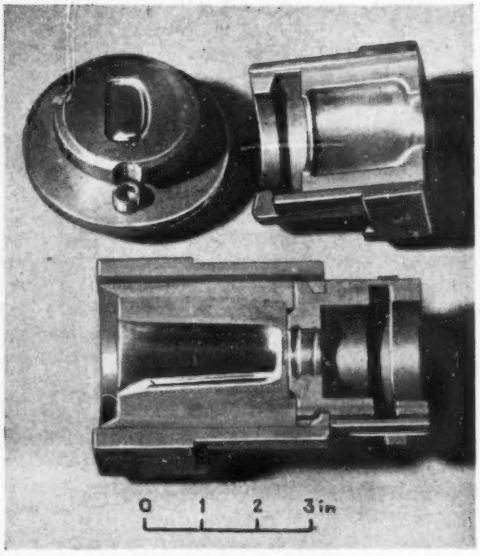

Fig. 2. Examples of glass bottle moulds which are made in quantities

The company's new works are well equipped with machines suitable for the production of a wide range of glass bottle moulds, examples of which are shown in Fig. 2. Machine tools include Myford, Brown and Sharpe, and Abwood grinders; C.V.A., Holbrook, and Willson centre lathes; Herbert, Ward and Modern capstan lathes; a Keller die sinking machine; a Profilomatic 3-dimensional copy miller; and a wide

range of other milling machines. Finishing is expedited by the use of flexible shaft-driven grinding and polishing heads. Moulds are supplied to many leading glass-bottle manufacturers.

The Growing Importance of Chemical Machining

(*Continued from page* 1503)

ever, according to Mr. Stearns, where "workable methods" have been established for applying chemical milling to practically all these materials. The greatest difficulty has been experienced with the cobalt-nickel alloys, "but these are now responding to the research efforts." Mr. Ferguson also made brief reference to chemical milling, as applied to Inconel X, and showed an integrally-reinforced skin panel produced by this method. The metal removal rate, he said, was about 0·001 in. per min., the surface finish approximately 100 micro-inches, r.m.s., and the thickness limits ±0·002 in. more than the limits on the sheet material.

It is evident, therefore, on the one hand, that very substantial progress has been made in the field of chemical machining in a comparatively short time, and, on the other, that producibility of elaborate shapes from materials that are extremely difficult to machine by other methods, will increasingly depend upon the effective exploitation of these new techniques. In conclusion, moreover, it should be noted that whereas chemical machining is at present of particular interest in connection with aircraft and missile production, the potential applications are by no means confined to complicated parts, nor to this field of activity.

Obituary

MR. V. WHITHAIR, managing director of Whithair Tools, Ltd., Church Road, London, W. 3, died recently.

MR. RICHARD LLOYD, a director of The Effingham Steel Works, Ltd., Sheffield, and London area manager of the associated firm, Marsh Brothers & Co., Ltd., has died suddenly from a heart attack. He joined the staff of Marsh Brothers in 1918 and was subsequently appointed to take charge of the sales office of The Effingham Steel Works. During the second world war he was a member of a sub-committee of the Machine Tool Control.

MR. WILLIAM E. WRIGHT, F.C.S., who was formerly a director of The Pyrene Co., Ltd., Great West Road, Brentford, Middlesex, died recently. He joined the company nearly 30 years ago and pioneered the use of phosphate coating processes in this country, on a production scale. Mr. Wright was responsible primarily for the Metal Finishing Division of the organization. His health had been failing for several years, and he resigned from the board at the end of 1957.

MR. CHARLES HERBERT SUMMERSKILL died recently at his home in Bridlington where he had lived since his retirement, in 1938, from the firm of Summerskill Bros. (now Swift-Summerskill, Ltd.), of which he was the senior partner. One of the last of the older generation of machine tool builders in the Halifax district, he was, in his younger days, a Rugby football player and cricketer of more than average ability. He was also a keen golfer. The interment was at Warby near Halifax, the home of Mr. Summerskill's family for generations. He leaves a widow and son—Mr. Harry Summerskill.

Display at Canadian Show

The Board of Trade, in conjunction with the Engineering Centre, is organizing a display of British engineering products at the National Industrial Production Show of Canada, which will be held in Toronto from May 4 to 8. It is announced in the latest issue of *News Letter* that the display will be staged in the main building of the exhibition, and it is suggested that it should be of interest to makers of many types of engineering products, including the following: machine tools, small tools, welding equipment, materials handling equipment, instruments, woodworking machines, hydraulic controls, furnaces and heat treatment equipment, automation devices, pneumatic equipment, and foundry equipment.

Full particulars can be obtained from Mr. A. J. Cox, General Manager, The Engineering Centre, Stephenson Place, Birmingham.

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31/12/58

G.T.M.A. Officers

At a recent meeting of The Gauge and Tool Makers' Association, Standbrook House, 2-5 Old Bond Street, London, W.1, the following officers were appointed for 1959.

PRESIDENT. Sir Stanley J. Harley, B.Sc., M.I.Mech.E., M.I.Prod.E. (chairman and managing director of Coventry Gauge & Tool Co., Ltd.).

VICE-PRESIDENTS. Mr. A. L. Dennison, M.I.Prod.E. (chairman of Birmingham Tool & Gauge Co., Ltd.); Mr. H. S. Holden, M.I.Prod.E. (managing director of The Brooke Tool Mfg. Co., Ltd.); Mr. T. Ratcliffe, M.I.Prod.E. (chairman and managing director of Ratcliffe Tool Co., Ltd.); and Mr. L. E. Van Moppes (chairman of L. M. Van Moppes & Sons [Diamond Tools], Ltd.).

CHAIRMAN. Mr. G. P. Barrott, M.I.Prod.E. (director and secretary of Precision Grinding, Ltd.).

VICE-CHAIRMEN. Mr. R. Kirchner, M.I.Mech.E., M.I.Prod. E. (deputy chairman and joint managing director of Arnott & Harrison, Ltd.); and Mr. H. G. Carmichael Wilson (chairman of John Harris Tools, Ltd.)

HON. TREASURER. Mr. J. C. Brown (director of Pitter Gauge & Tool Co., Ltd.)

Machine Tool Share Market

Stock markets were mainly firm during the period under review, and a good volume of business was maintained in most sections. British Funds and kindred stocks met with steady investment support which led to an improvement in values.

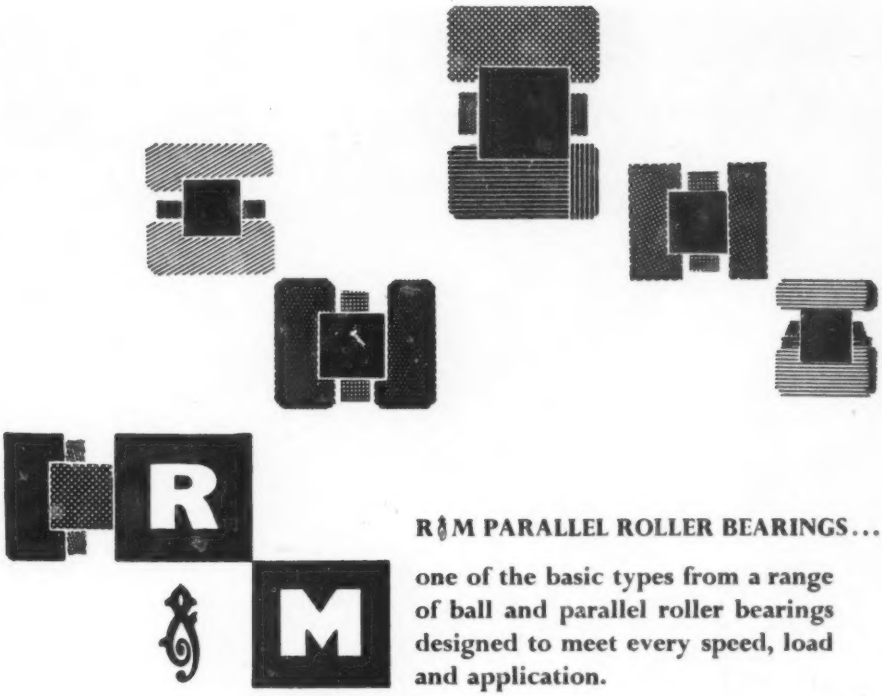
Commercial and industrial share markets showed a bright tendency, and although there was some irregularity in price movements, the majority of changes were favourable on balance, and a number of good features was in evidence.

Among machine tool issues, Asquith Machine Tool advanced 1s. 3d. to 25s. 3d.; Alfred Herbert, 1s. 3d. to 38s. 9d.; Kitchen & Wade, 1s. 3d. to 15s.; Birmingham Small Arms, 1s. 6d. to 36s. 6d.; British Oxygen, 2s. to 45s. 9d.; Broom & Wade, 3d. to 11s. 6d.; Geo. Cohen, 3d. to 11s. 3d.; Clarkson Engineers, 1s. 3d. to 18s. 9d.; John Holroyd "A," 1s. to 14s. 6d.; John Holroyd "B," 9d. to 14s. 3d.; Stedall & Co., 9d. to 8s. 3d.; and Thos. W. Ward, 2s. 6d. to 84s. 9d. On the other hand, Churchill Machine Tool lost 3d. at 16s. 4½d.; Craven Bros. (Manchester), 1½d. at 6s. 9d.; Samuel Osborn, 1s. 6d. at 18s.; and Edgar Allen, 2s. at 36s.

B. & S. MASSEY, LTD.—Interim dividend 5 per cent (same).

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/9
Allen (Edgar) & Co., Ltd.	Ord.	£1	36/-
" " "	5% Prf.	£1	15/6*
Arnott & Harrison, Ltd.	Ord.	4/-	15/-
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	25/3
" " "	6% Cum. Prf.	£1	18/9
Birmingham Small Arms Co., Ltd.	Ord.	£1	36/6
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	18/-
" " "	4% 1st Mort. Deb.	Stk.	88½
British Oxygen Co., Ltd.	Ord.	£1	45/9
" " "	6½% Cum. Prf.	£1	21/9
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	3/10½
Broom & Wade, Ltd.	Ord.	5/-	11/6
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	16/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	18/6xd
Butler Machine Tool Co., Ltd.	Ord.	5/-	10/-
" " "	5% Cum. Prf.	£1	14/6
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	11/3xd
Churchill (Charles) & Co., Ltd.	Ord.	2/-	6/-
" " "	6% Cum. Prf.	£1	26/6
Churchill Machine Tool Co., Ltd.	Ord.	5/-	16/4½
" " "	6% Cum. Prf.	£1	18/3
Clarkson (Engrs.), Ltd.	Ord.	5/-	18/9
Cohen (George), Sons & Co., Ltd.	Ord.	5/-	11/3
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	17/6
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	6/9
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/9
" "	4½% Red. Cum. Prf.	£1	13/9xd
Expert Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6
Greenwood & Batley, Ltd.	Ord.	£1	57/6
Harper (John) & Co., Ltd.	Ord.	5/-	16/9
" " "	4½% Red. Cum. Prf.	£1	13/3
Herbert (Alfred), Ltd.	Ord.	£1	38/9
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	14/6
" " "	"B" Ord.	5/-	14/3
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	21/-
" " "	7% Cum. Prf.	5/-	5/-xd
Kayser, Ellison & Co., Ltd.	Ord.	£1	44/9
" " "	6% Cum. Prf.	£1	18/-
Kendall & Gent, Ltd.	Ord.	5/-	8/-
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/10½
Kitchen & Wade, Ltd.	Ord.	4/-	15/-xd
Martin Bros. (Machinery), Ltd.	Ord.	2/-	1/10½
Massey, B. & S., Ltd.	Ord.	5/-	9/9
Modern Engineering Machine Tools Ltd.	Ord.	5/-	11/6
Newall Engineering Co., Ltd.	Ord.	2/-	4/6
Newman Industries, Ltd.	Ord.	2/-	2/9
" " "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	18/-
" " "	5½% Cum. Prf.	£1	25/6
Pratt (F.) & Co., Ltd.	Ord.	5/-	22/6
Scottish Machine Tool Corporation Ltd.	Ord.	4/-	5/3
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	37/6xd
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	10/1½ ex rights
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	14/-
" " "	5% Cum. Prf.	£1	15/-xd
Stedall & Co., Ltd.	Ord.	5/-	8/3
	"B" non-voting Ord.	10/-	22/6
Sykes (W. E.), Ltd.	Ord.	5/-	7/6
Tap & Die Corporation, Ltd.	4½% Deb. 1961-1977	Stk.	82/-
" " "	Ord.	10/-	18/9
Wadkin, Ltd.	Ord.	£1	84/9
Ward (Thos. W.), Ltd.	5% Cum. 1st Prf.	£1	16/-xd
" "	5% Cum. 2nd Prf.	£1	23/6xd
" "	Ord.	1/-	2/4½xd
Willson Lathes, Ltd.			

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.



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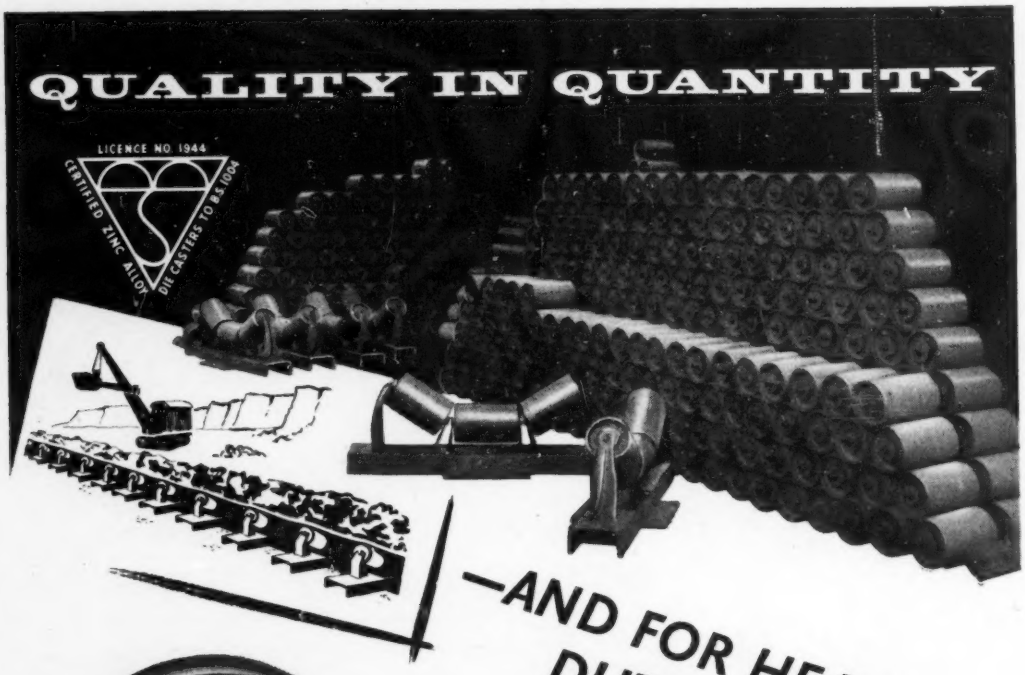

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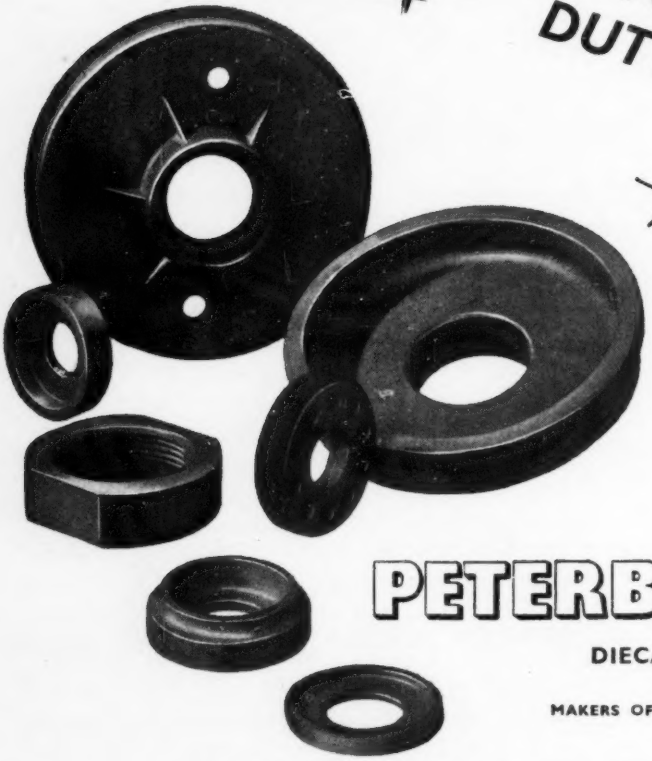

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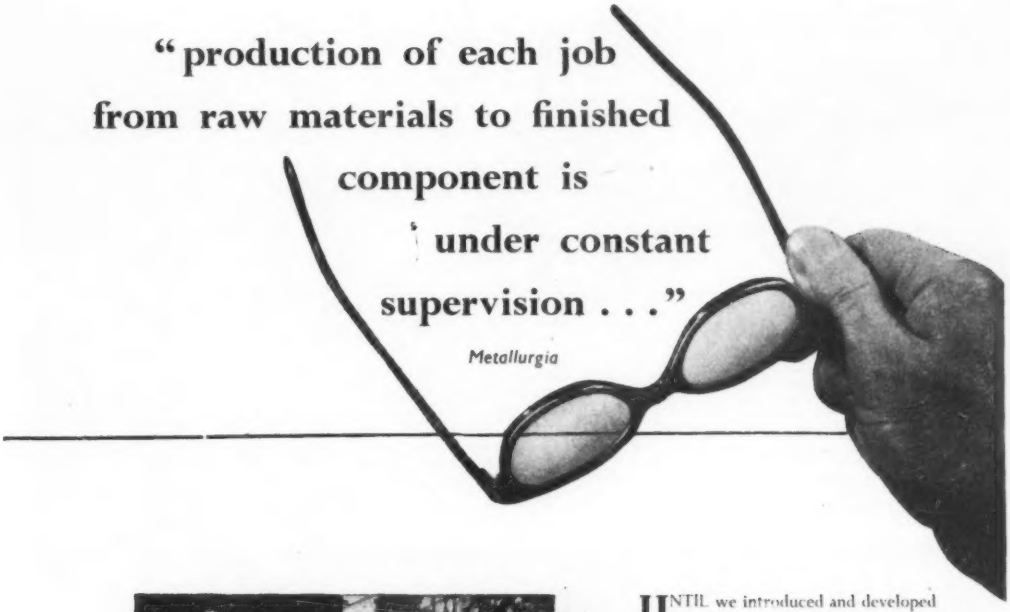

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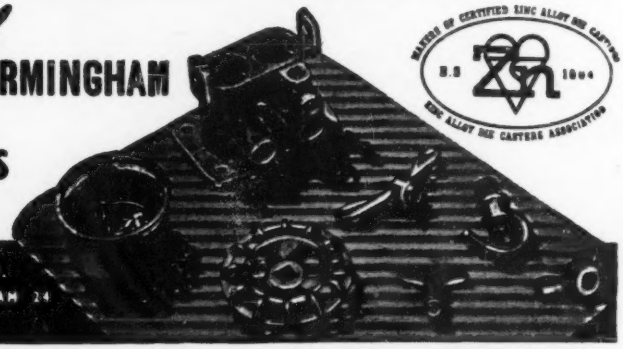

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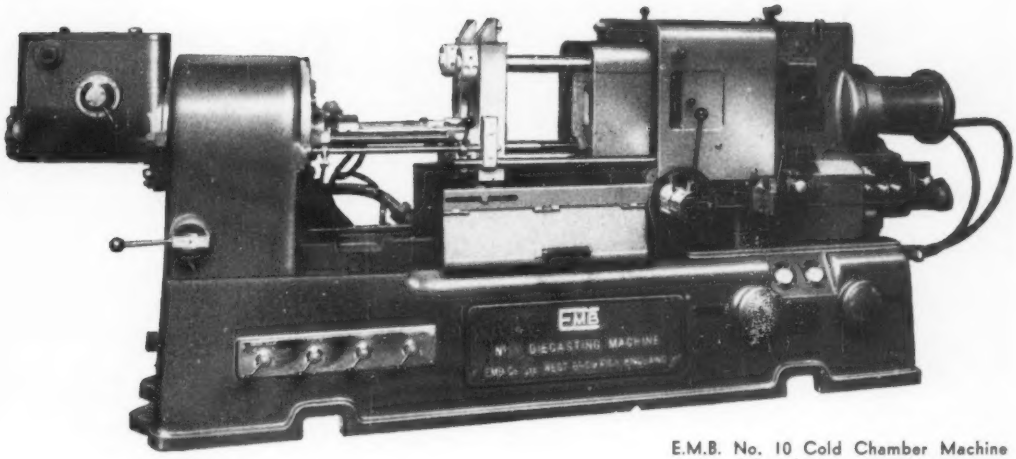

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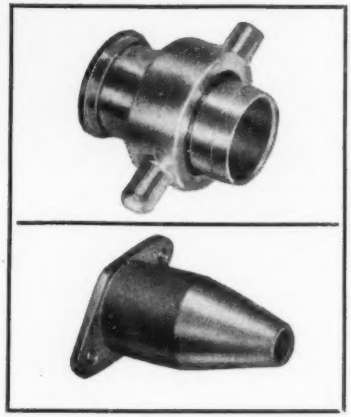

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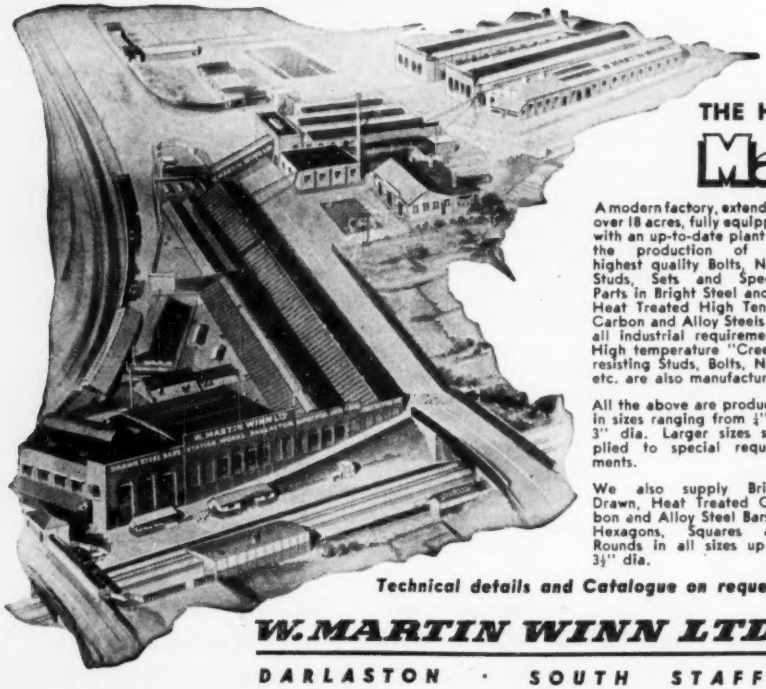

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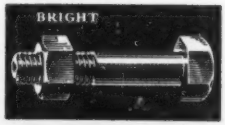

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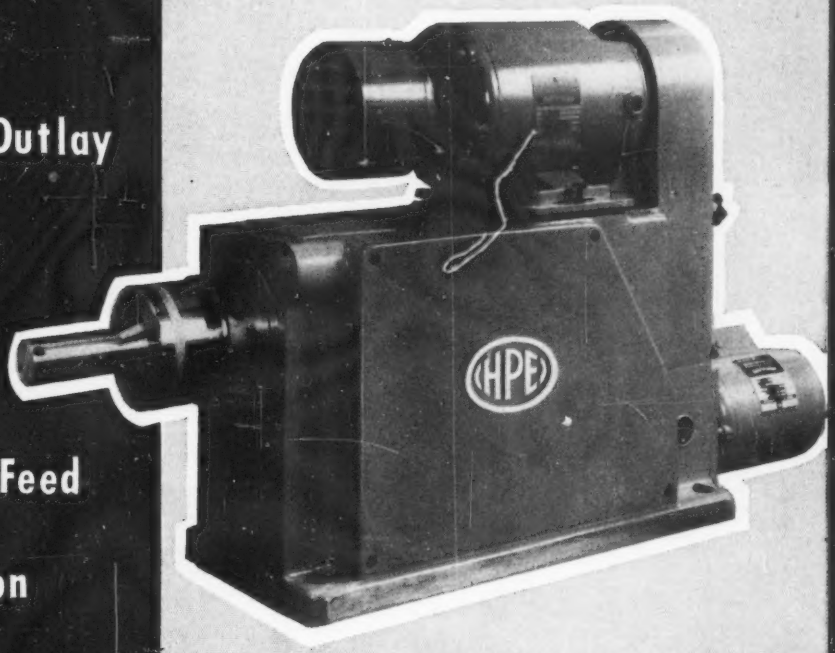

The FB4F Fine Boring Unit Head illustrated above incorporates an independent feed motion, transmitted to its spindle quill through a simple plate cam, which can be designed to give a fast approach and varying rates of feed. The robust spindle and quill, together with super precision spindle bearings, ensure a high degree of finish and roundness.

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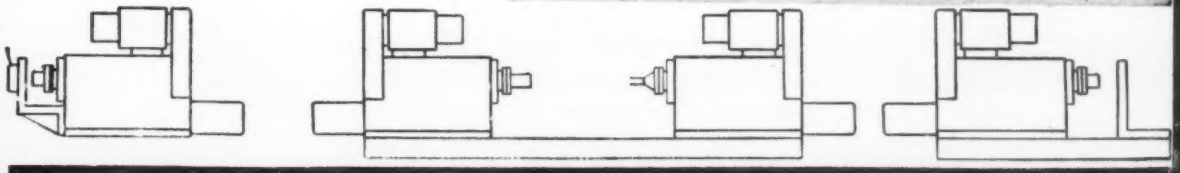

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TYPE N.T. ABRASIVE CUT-OFF MACHINE NEW

HYDRO CUSH/PUSH TRAVELLING WHEEL HEAD INCORPORATING FOOT OPERATED PLUNGE CUTTING ACTION
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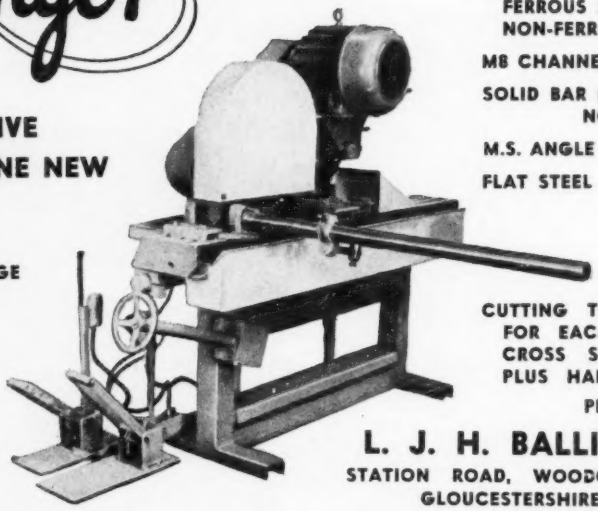
OTHER MACHINES ARE ALSO AVAILABLE



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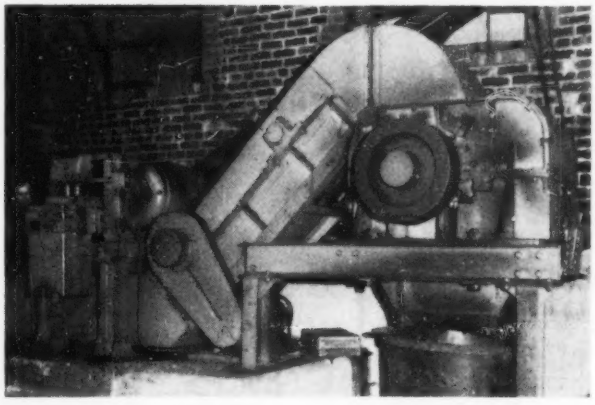
feeder . . .
breaker . . .
discharge . . .

The photograph shows a very neat set-up at the Leeds Works of British Screw Co. Ltd. who reduce their swarf to small sizes with a B.J-D Swarf Breaker and Mechanical Feeder.



Many producers of swarf are using these B.J-D machines to keep down the volume of swarf, making it acceptable either for re-use in the furnace or for sale to scrap merchants.

BJD **swarf breaker & feeder**

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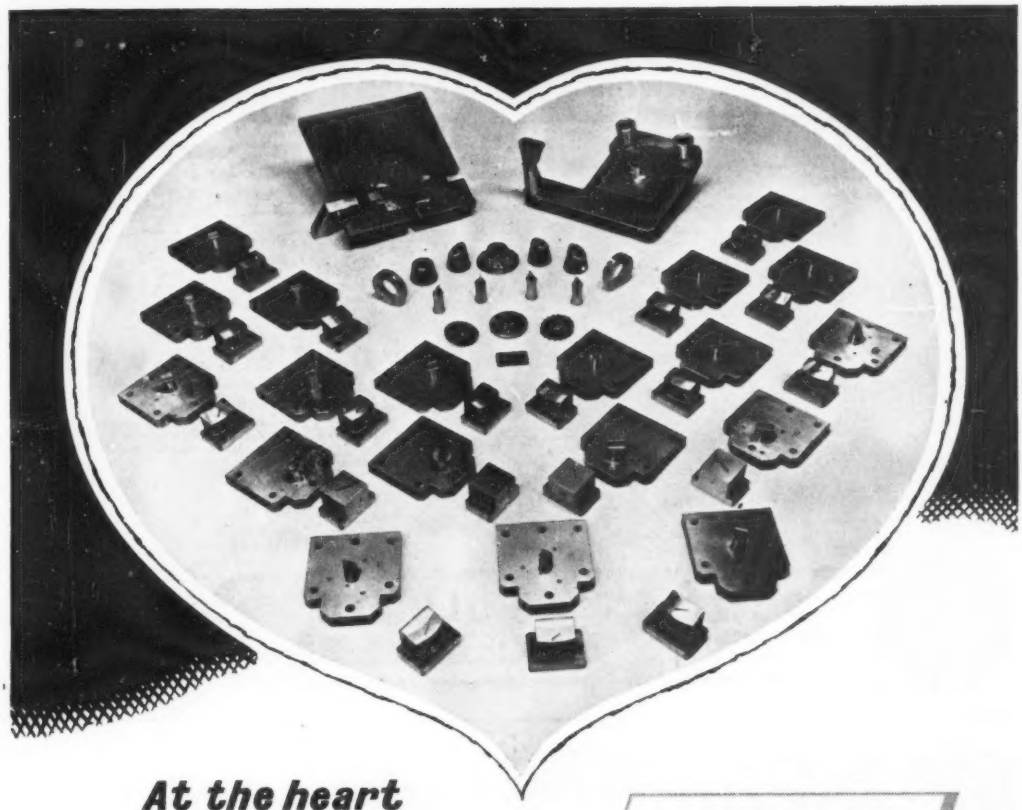

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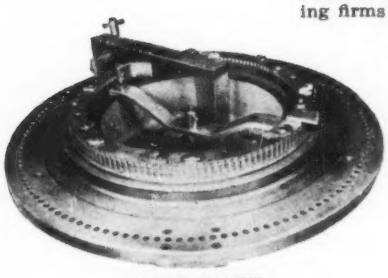

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S3

For CONSISTENT ACCURACY
—right up to the Last Thread

BRITISH BUILT

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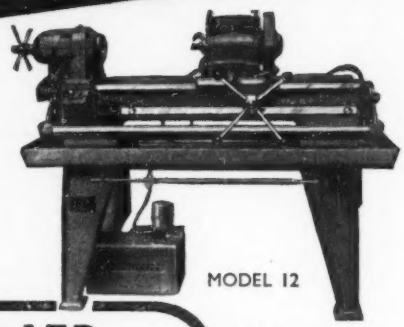
UNIVERSAL THREAD MILLERS

For repetition threading—both external and internal. Accuracy of pitch, form and depth maintained right up to the last thread. A micrometer dial is provided for setting, and one or more cuts can be taken according to the finish required. The automatic cycle permits ease of operation.

	Diameter Ext.	Int.	Cutting times	Pitch
Model 11	3"	3"	5 – 102 sec.	8 – 40 t.p.i.
Model 12	6"	5"	20 – 140 sec.	,,

Stock delivery. Standard Hobs available from stock.



MODEL 12

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Ask us to send the detailed catalogue.

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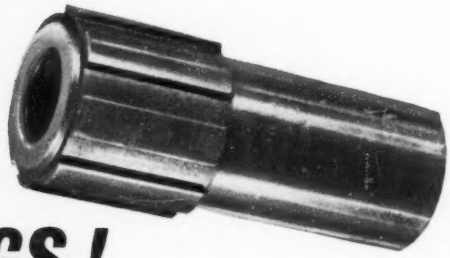
NO MACHINING NEEDED WITH SINTERINGS!



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Martonair Flow Regulators are used extensively to control the speed of pneumatic cylinders. Normally fitted between the outlet port of the control valve and the cylinder, the regulator allows free flow into the cylinder but controls the flow to exhaust by orifice adjustment. The S.837 regulator illustrated here gives provision for in-line connection and is suitable for the speed control of cylinders up to 4" diameter bore. The taper for the adjusting needle has been specially designed to give not the usual wide parabolic flow curve but equal sensitivity of control at both large and small openings; each turn of the needle involves an increase of approximately 40% on flow and cylinder speed. Precise control can thus be obtained.

Send for leaflet B87 which gives full details of the Martonair S.837 Flow Regulator

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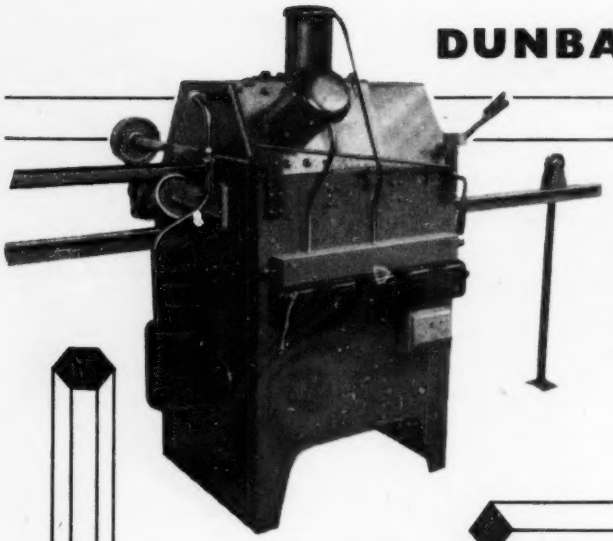

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The Bar Cleaning Machine illustrated is one of the many Special Purpose Machines of our manufacture. Attractive deliveries are offered for the design and manufacture of all types of jigs and fixtures.

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Fabricated steel construction.
Stroke fully adjustable over whole ram travel.
Hand lever operation—ram returns automatically when released.
Non-Rotating Ram.
Unloading and Retaining Valve —allows ram to be held under pressure without overheating the oil.
Removable footstock.
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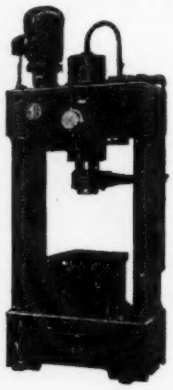
From 15-tons to 500-tons Capacity.



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Fabricated Steel Construction.
Hand and foot control.
15" Ram stroke (adjustable) with power return.
Advance speed 200" per minute.
Return speed 240" per minute.
Power speed 22" per minute.
Machine illustrated has 5'-6" long table.
Other sizes available.

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Straightening Equipment and sensitive control.
Pressure trip for automatic ram return.
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Special features available

Ejector or dashpot.
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automatic cycling
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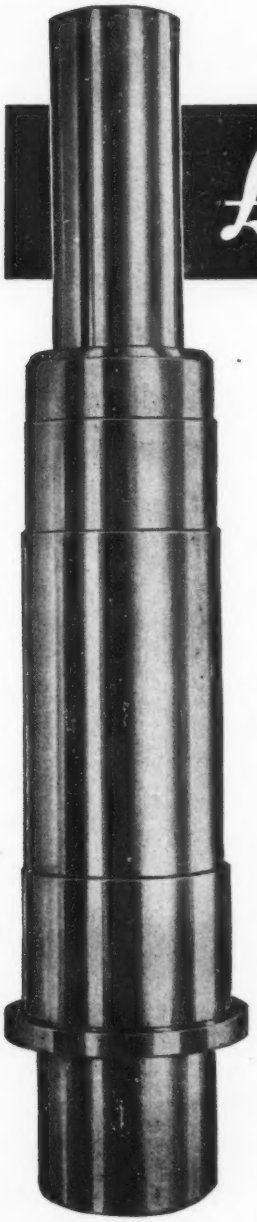

£19-5-0 saved

on each of these

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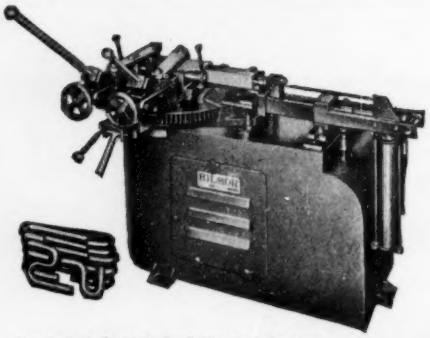
H644

BENDING MACHINERY



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Hand operated and Hydraulic Portable benders for jobbing and maintenance purposes.

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Motorised and Electro/Hydraulic Semi-Automatic and Automatic machines for long run production bending.

Machines can be tooled to bend square, oval, elliptical and other non-round Tubes, Finned Tubes and Angles, Section and Extrusions.

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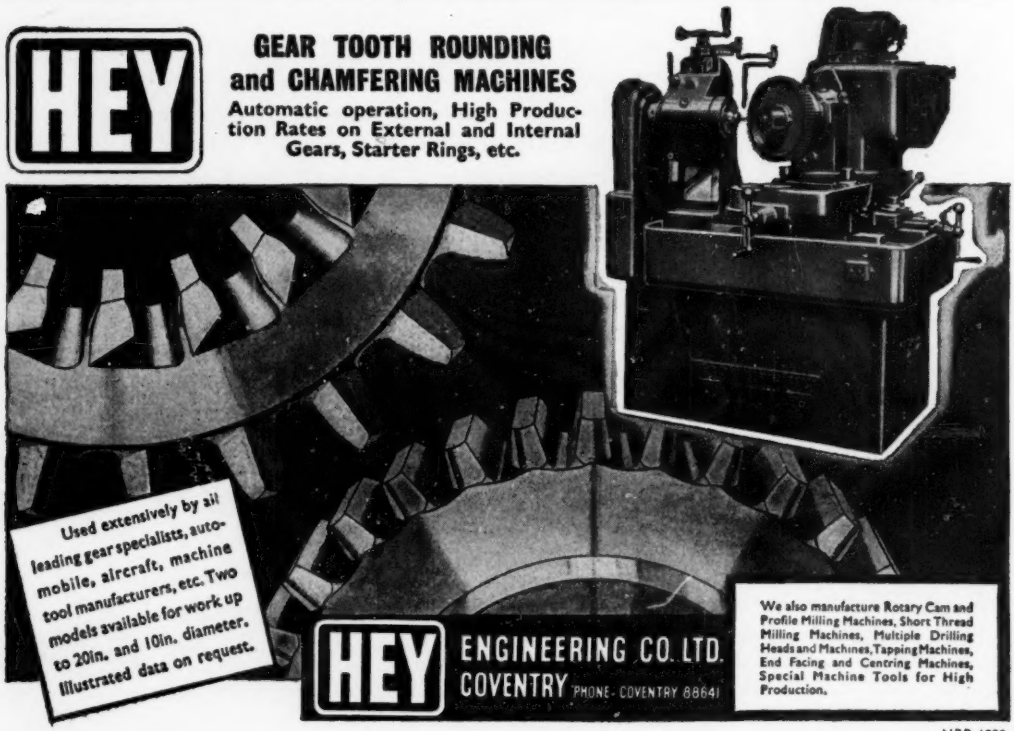
Automatic operation, High Production Rates on External and Internal Gears, Starter Rings, etc.



Used extensively by all leading gear specialists, automobile, aircraft, machine tool manufacturers, etc. Two models available for work up to 20in. and 10in. diameter. Illustrated data on request.

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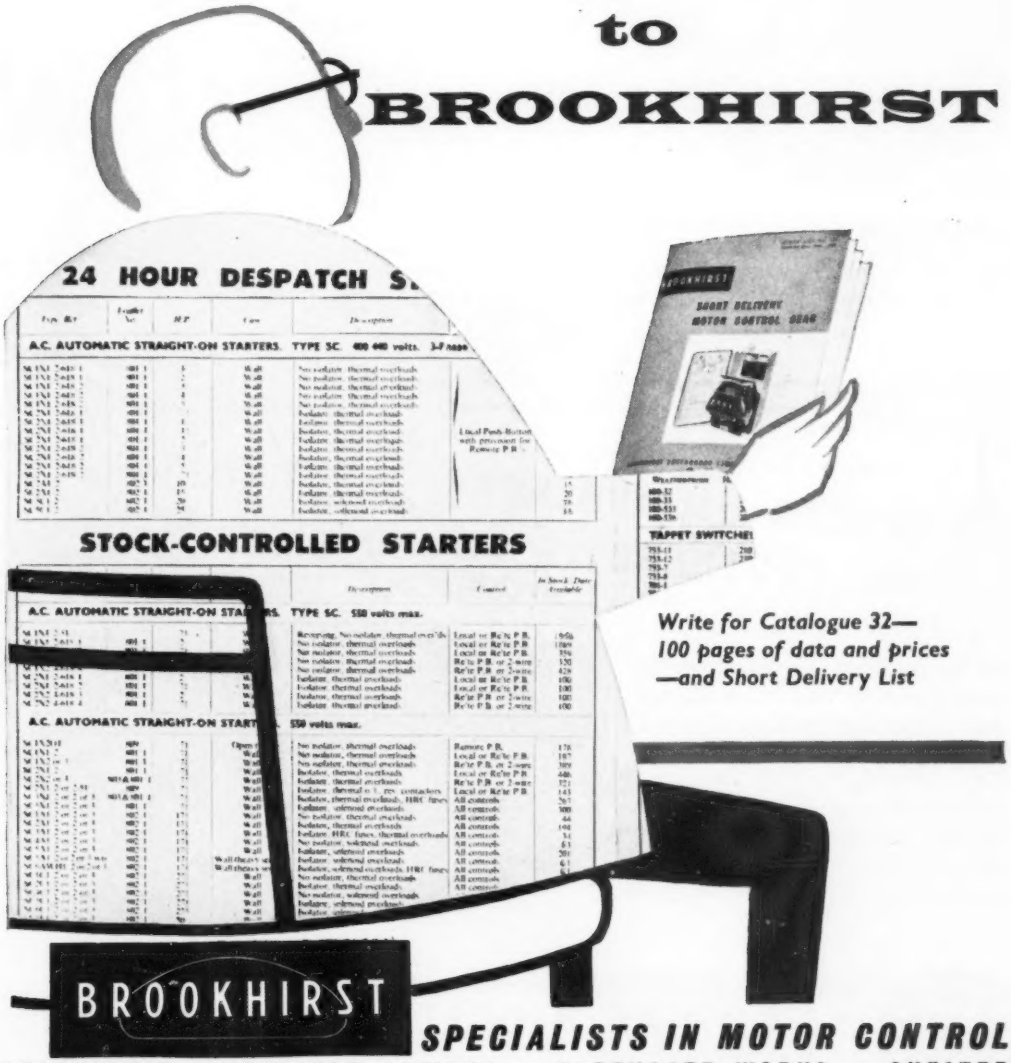
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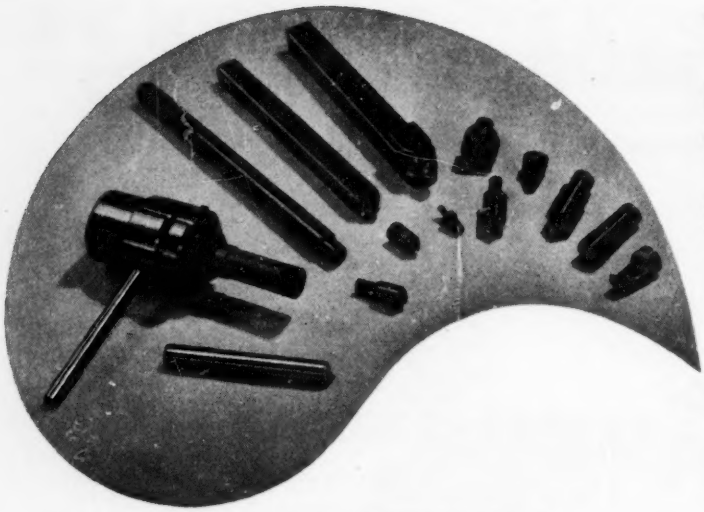

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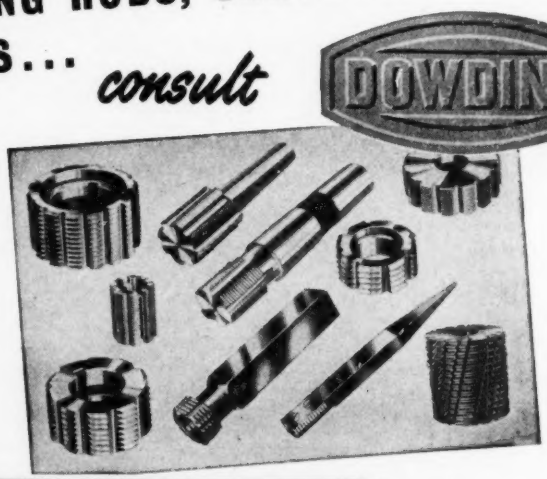

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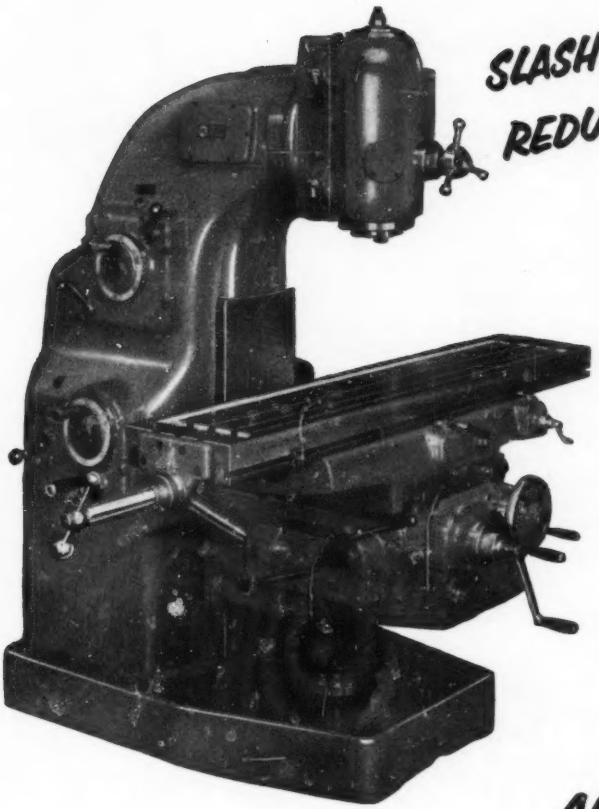
ARNO VERTICAL MILLER

3L DIAL TYPE



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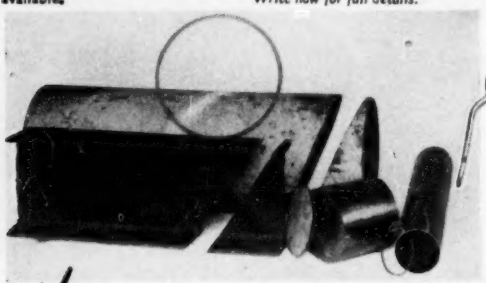
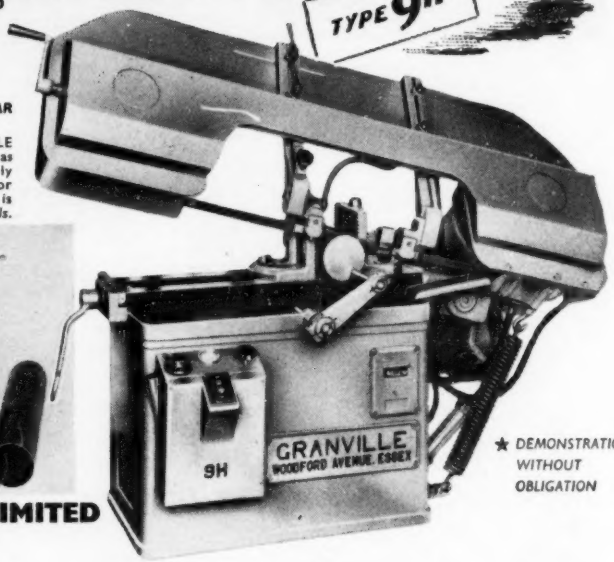
GRANVILLE *High Speed* BANDSAW

TYPE 9H

- POSITIVE CONTROLLED HYDRAULIC FEED GIVES SUPER FAST CUTTING ON BARS TUBES, ANGLES AND SECTIONS
- NO WASTE: CUT ONLY 0·05 in. WIDE
- ACCURATE: TO WITHIN ±0·005in. on 4in. BAR

Specially designed for production cutting-off, the GRANVILLE will handle bars, tubes, angles and even sections as large as 13¼in. × 6in. at super-fast speeds. Ample power, positively controlled hydraulic down-feed. A precision setting device for fine adjustment of vice angle within 15mins. of a degree is available. *Write now for full details.*





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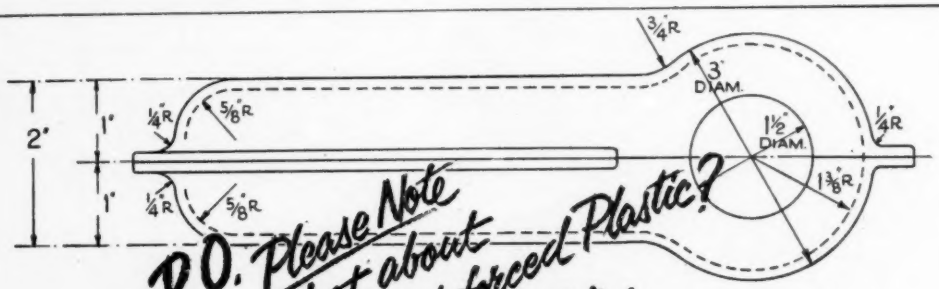

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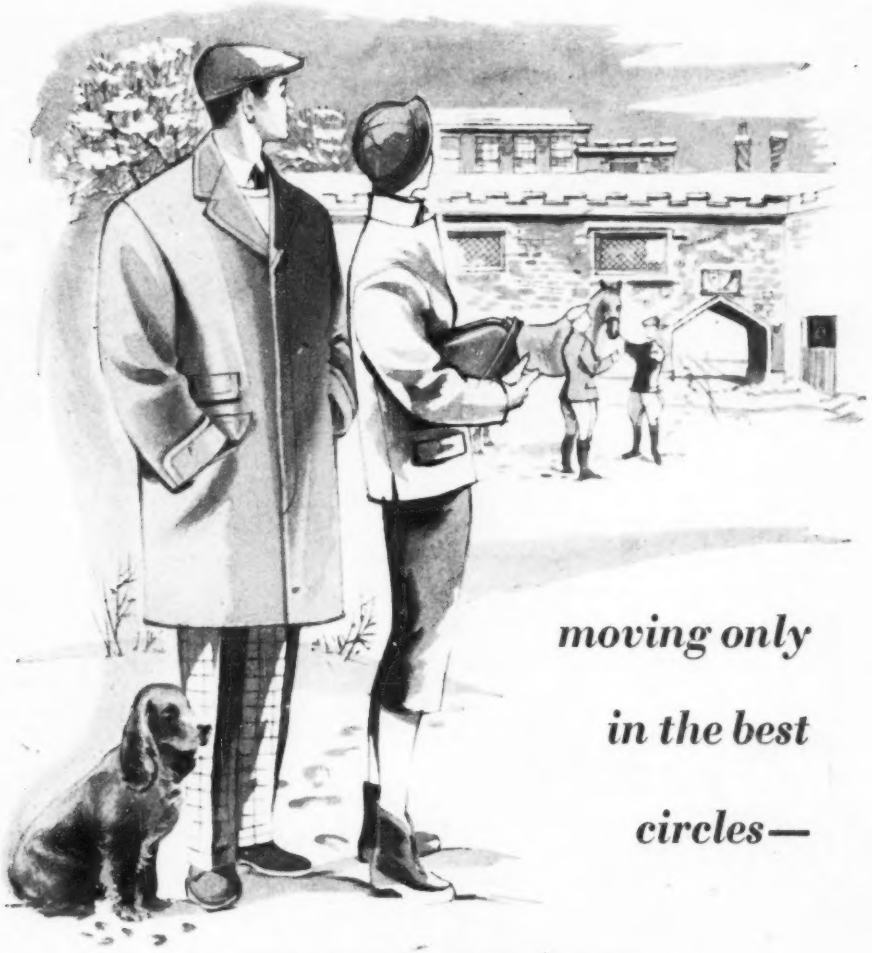

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the polished drill
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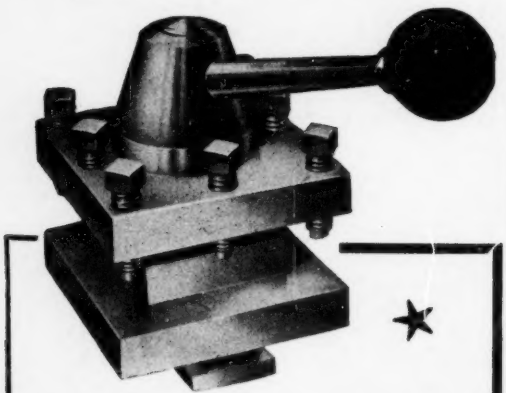

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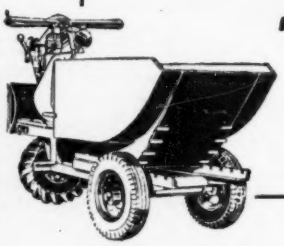

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- Sheet steel fabricated body
- 8 cwt. load capacity
- Body width: 2ft. 6in.
- Roll top tipping body

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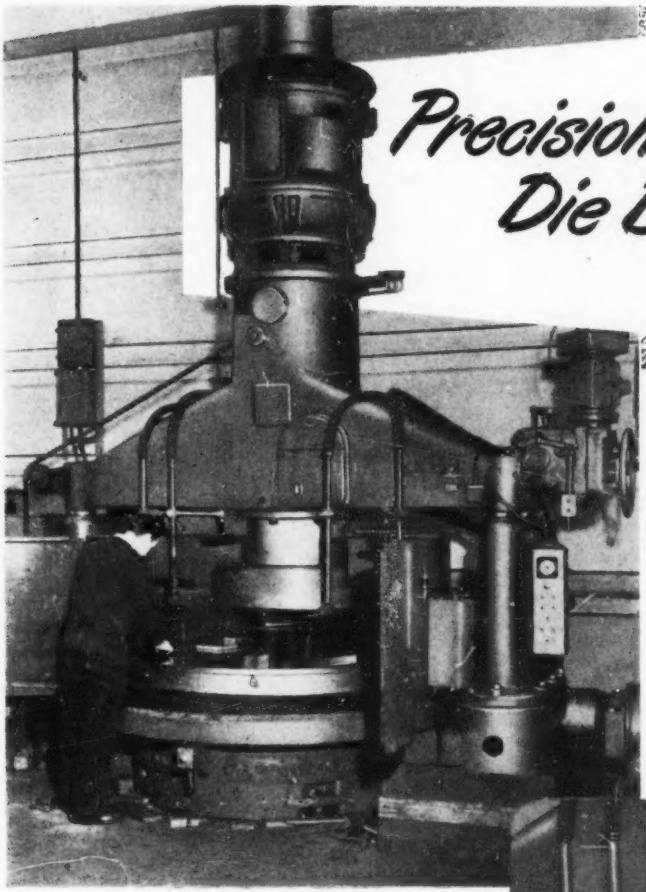

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at PRESSED STEEL

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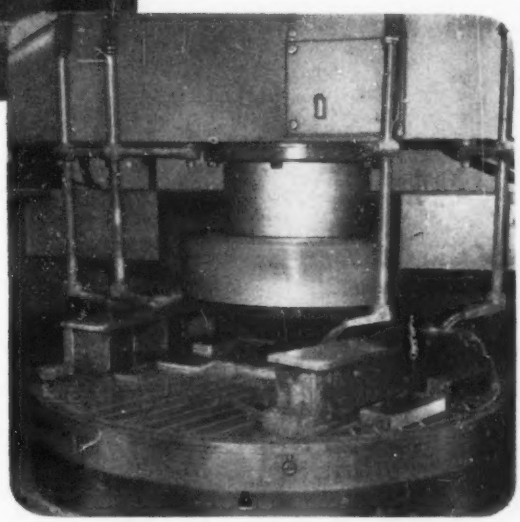

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MODEL 94 LE

SURFACE GRINDERS

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M2

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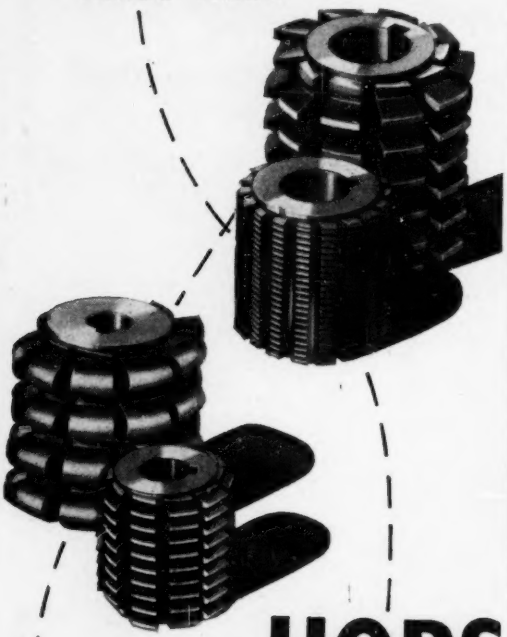

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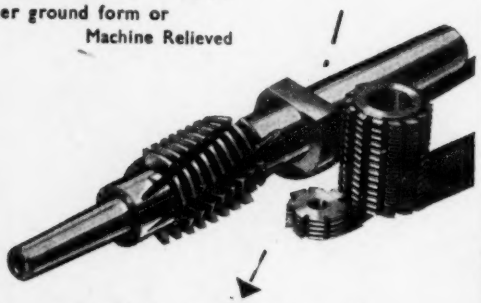
SUPER HIGH SPEED STEEL
either ground form or Machine Relieved



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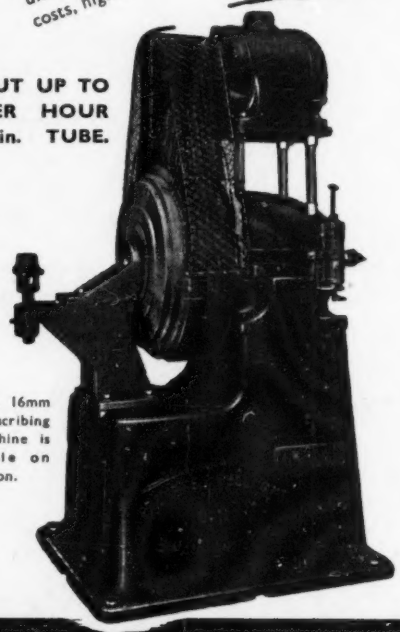
COLD TAGGING MACHINE

Backed by 30 years' experience in building rotary swagers, the makers have designed this new machine especially for cold tagging steel and non-ferrous tube or bar. Four dies are mounted in a fixed head and do not rotate. THERE IS NO POSSIBILITY OF THE DIES REVOLVING THE TUBE risking injury to the operator. Advantages are a uniform strong tag, no heating and furnace costs, higher production.

OUTPUT UP TO 200 PER HOUR ON 2in. TUBE.



A short 16mm film describing this machine is available on application.

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The Roto-Finish story No. 4 of a series
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RADIUS GRINDING ATTACHMENT FOR MILLING CUTTERS *(Patent applied for)*

- NEW
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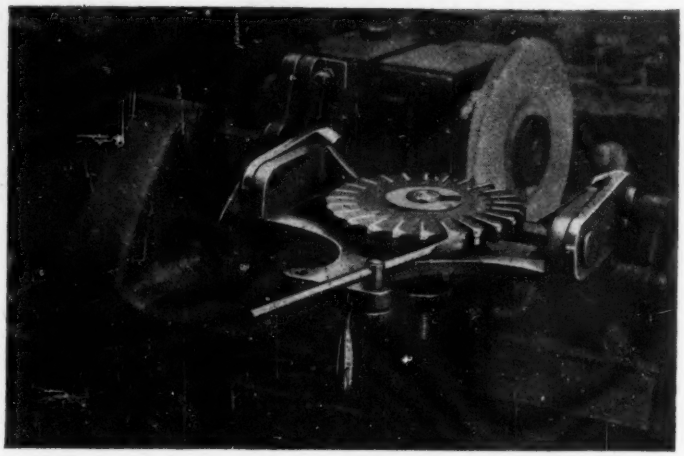
For accurate convex radii on:
Side and Face Cutters
Slotting Cutters
Angle Cutters

Can be used on standard types of Cutter Grinders, Cylindrical Grinders, or Lathes fitted with toolpost grinding attachments.

CAPACITY:
Cutters 3in. to 8in. dia., 1¼in. wide
Radii ... ... Up to ⅝in.



Full particulars on application

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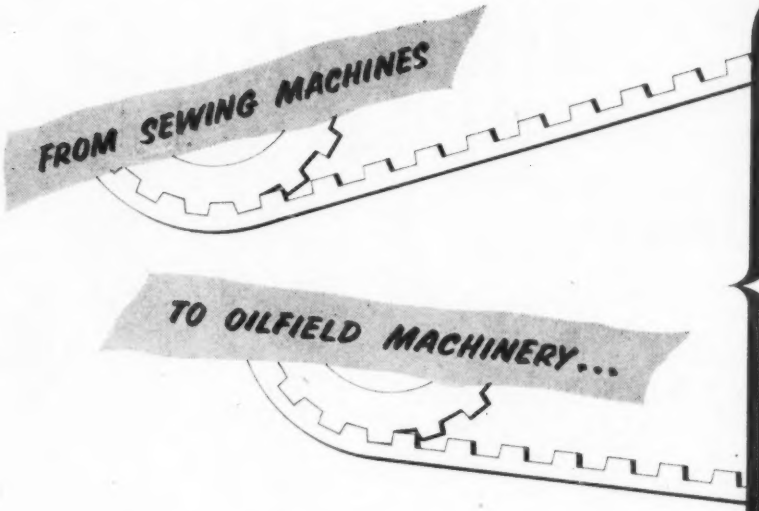

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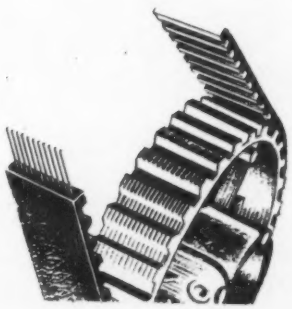

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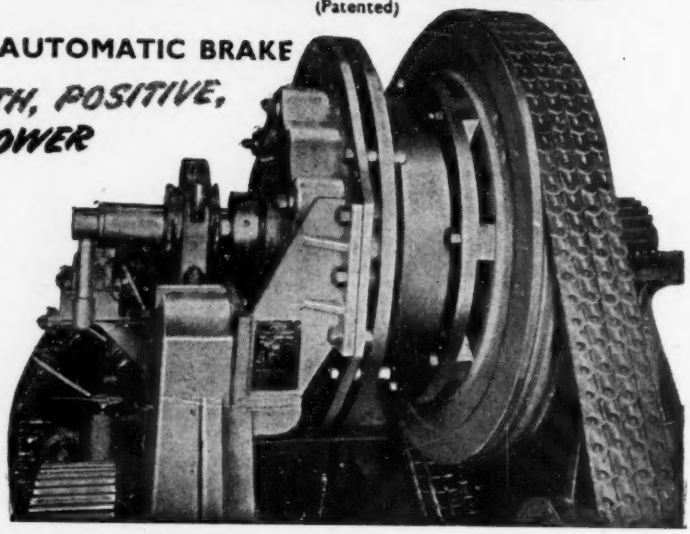

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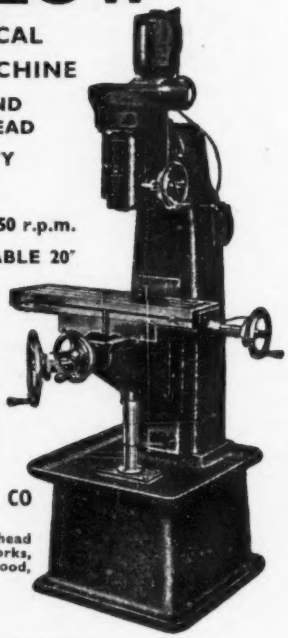

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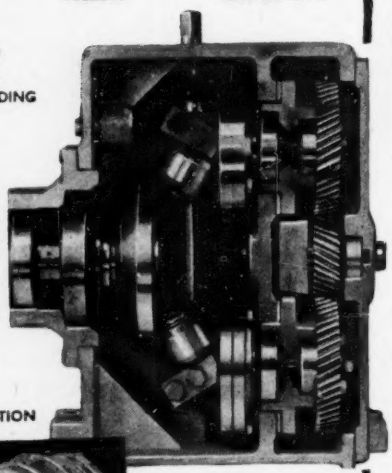

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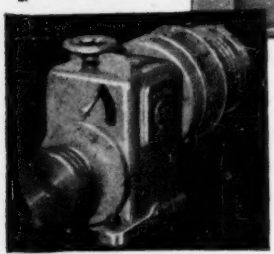

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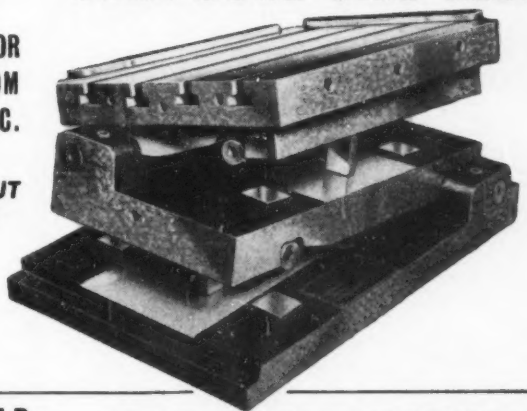

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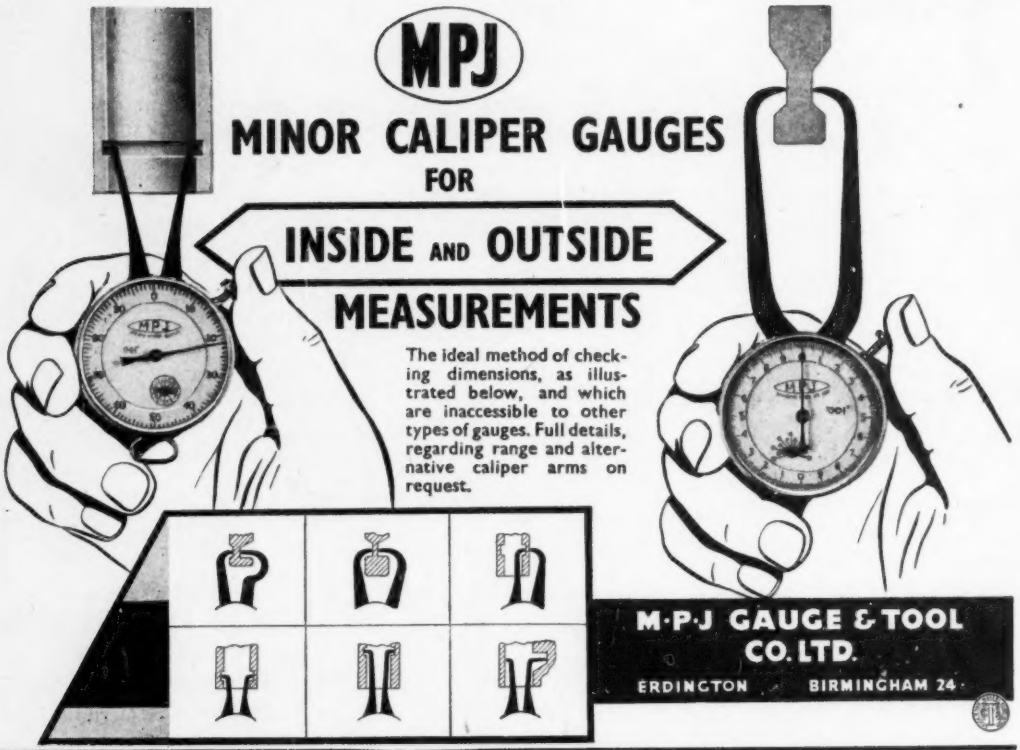

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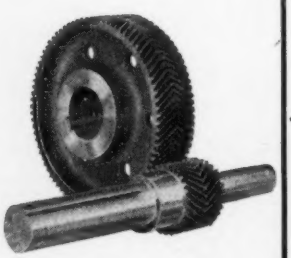

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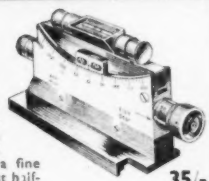

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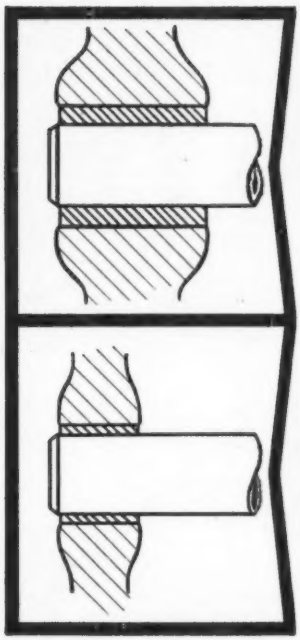

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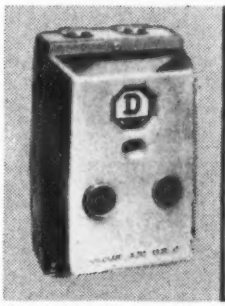

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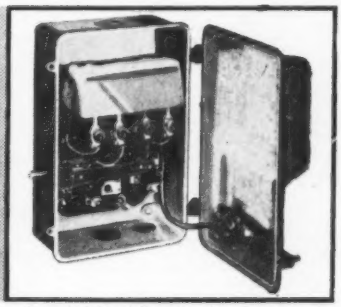

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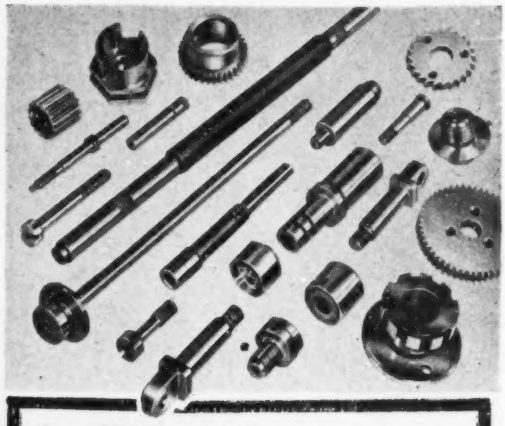

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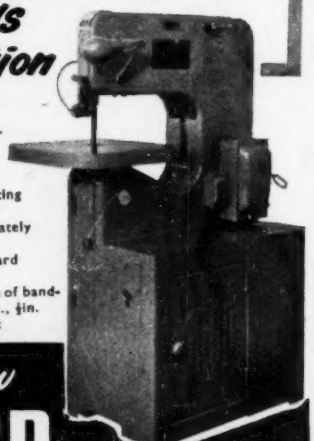

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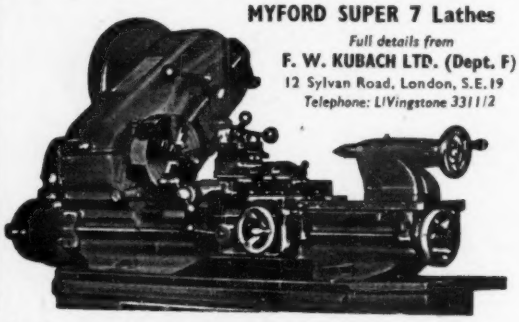

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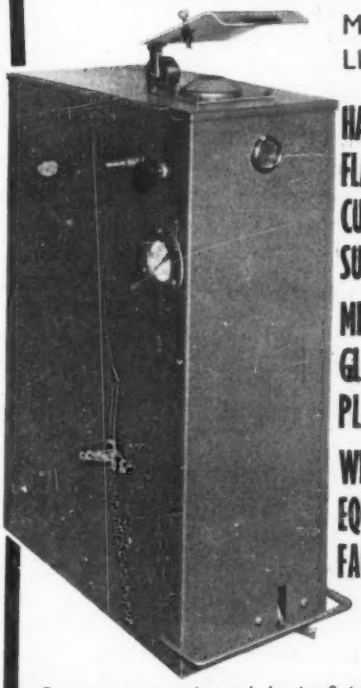

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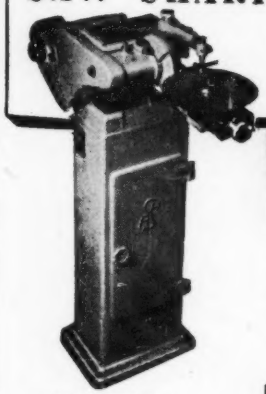

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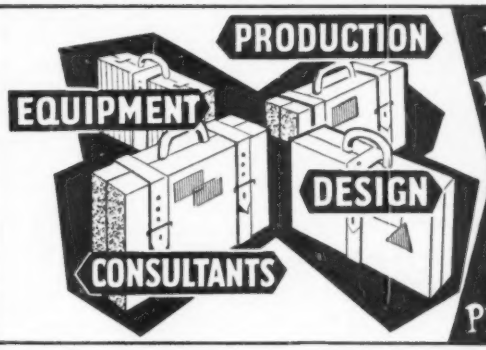

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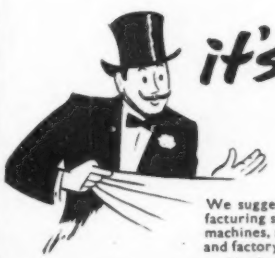
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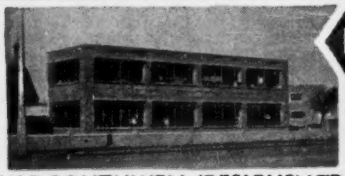

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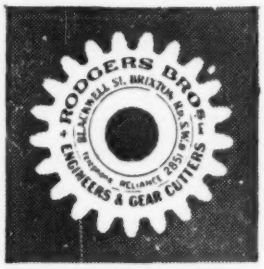

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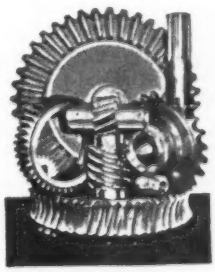

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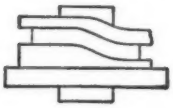

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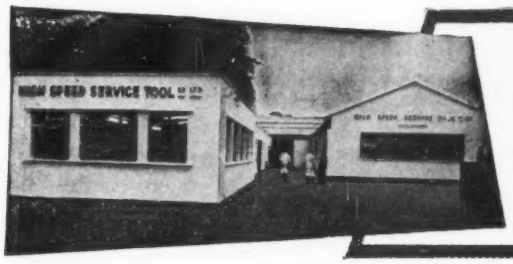

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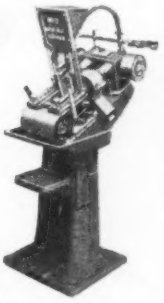

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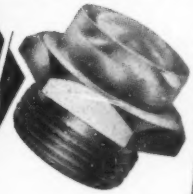

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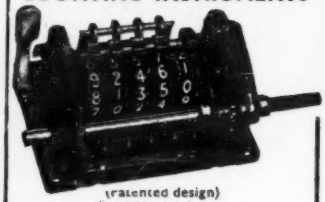

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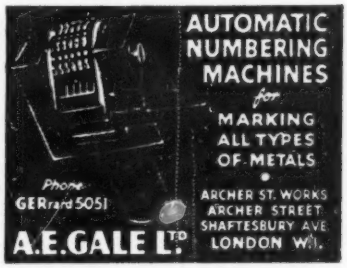

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ARCHDALE 20in. Production Milling Machine. Speed Range 30-619 r.p.m.
BROWN & SHARPE No. 10 Production Milling Machine. Speed Range 55-1,800 r.p.m.
WARD 7 Combination Turret Lathe. Taper Turning. Bar Feed and Chucking. Speed Range 37-750 r.p.m. Comprehensive equipment.
WARD 7, 3A, 2A, 1A Capstan Lathes, arranged Bar Feed.
NORTON 16in. × 50in. Universal Grinding Machine. Comprehensive Equipment.
CHURCHILL 12in. × 36in. Universal Grinding Machine. Comprehensive equipment.
NEWALL Type L 10in. × 36in. Plain Grinding Machine.
JONES & SHIPMAN 10in. × 27in. Plain Grinding Machine.
B.S.A. Landis Type C 6in. × 18in. Plain Grinding Machine.
CHURCHILL 24in. Ring Grinder.
CHURCHILL 42in. Ring Grinder.
SCRIVENER 2C Centreless Grinder.
HENDEY 24in. × 168in. S.S. & S.C. Lathe. Speed Range 14-560 r.p.m.
F.L.C.B. 17in. × 10ft. S.S. & S.C. Lathe. Speed Range 1.08-152 r.p.m.
OLDFIELD & SCHOFIELD 15in. × 8ft. S.S. & S.C. Lathe. Gap Bed. Speed Range 6.5-332 r.p.m.
OLDFIELD & SCHOFIELD 12½in. × 7ft. S.S. & S.C. Lathe. Gap Bed. Speed Range 12-400 r.p.m.
MONARCH 16in. × 30in. Type CY S.S. & S.C. Lathe. Speed Range 14-600 r.p.m.
CINCINNATI Type LT 8in. × 5ft. S.S. & S.C. Lathe. Speed range 16-392 r.p.m.
LANG 9in. × 5ft. 6in. S.S. & S.C. Lathe. Speed Range 8.75-240 r.p.m.
DEAN SMITH & GRACE 7in. × 3ft. 6in. S.S. & S.C. Lathe. Gap Bed. Speed Range 11-490 r.p.m.
DEAN SMITH & GRACE 7in. × 2ft. 6in. S.S. & S.C. Lathe. Gap Bed. Speed Range 11-490 r.p.m.
DENHAM 6½in. × 3ft. 0in. S.S. & S.C. Lathe. Gap Bed. Speed Range 10-400 r.p.m.
KITCHEN & WADE 5ft. No. 5 M.T. Radial Drilling Machine. Speed Range 20-1,000 r.p.m.
TOWN 3ft. No. 3 M.T. Radial Drilling Machine. Speed Range 126-1,450 r.p.m.
ARCHDALE 4ft. No. 4 M.T. Radial Drilling Machine. Speed Range 80-2,000 r.p.m.
ARCHDALE 3ft. No. 2 M.T. Radial Drilling Machine. Speed Range 126-1,440 r.p.m.
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CLIFTON & BAIRD Punching and Cropping Machine. Cap. 4½in. × 4½in. × ½in. angle.
BIGWOOD 4 Roll Bending and Straightening Machine. Cap. 4ft. × ½in.
Modern Machines—Motorised 400-440/3/50. Fully Overhauled—Six months' Guarantee.

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HERBERT 3A Chucking Auto.
ACME-GRIDLEY, Type R, 4-spindle, ⅝in. capacity.
ACME-GRIDLEY, Type R, 4-spindle, 1⅛in. capacity. (2 machines.)
WICKMAN 4mm. Swiss Type.
RYDERMATIC No. 12 Multi Tool Lathes.
INDEX 52.

GRINDERS

CHURCHILL No. 2 Hydraulic Spline-shaft Grinder.
ABWOOD Vertical Spindle Surface.
BROWN & SHARPE No. 2 Surface Grinder.
JONES & SHIPMAN Fig. 62M Plain Cyl., 8in. dia. by 10in.
LANDIS 10in. by 18in. Plain Grinder.
CHURCHILL 24in. by 10in. Universal.
BRYANT 16C 16in. Internal Grinder.
SMART & BROWN Internal Grinder.
ROWLAND Three Wheel Carbide Tool Grinder and Lapper.

CAPSTAN LATHES

HERBERT No. 0 ¼in., collet cap. (2).
MURAD ¼in. Capstan Lathe.
WARD 2A.
SOUTHWARK No. 2 1¼in. Capstan Lathe.
DRUMMOND Type K Capstan Lathes (2).
GISHOLT No. 4 Friction Head Capstan.
LIBBY 4R 2in. Capstan Lathe. Bar feed.
BARDONS & OLIVER No. 5 Capstan Lathe.
HERBERT No. 7 Turret Lathe.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES

SOAG OXFORD 6½in. Centre Lathe.
SOUTHBEND 13in. swing taper turning.
WILLSON 8½in. A.G.H. Lathe.
CARDIFF 8½in. by 48in. Lathe.
SWIFT 13in. Centre height 18ft. between, gap bed.

MILLERS

KENT-OWEN 1-8 Hydraulic Horizontal.
VICTORIA MO Plain.
New VICTORIA U1 and U2 Universal.
ARCHDALE 20in. Horizontal Mills (3).
RICHMOND VHM Vertical Mill.
HLLROYD T117 Thread Miller.
HELLER Automatic Thread Millers (4).

MISCELLANEOUS

TAYLOR No. 1 Cutting-off Machine for Tubes and Bars.
JONES & SHIPMAN 2-spindle Pillar Drill, with No. 3 M.T. spindle, power feed.
New ESSEX 18 Bandsaw.
New RICHMOND SR2 3ft. Radial Drill.

All Machines motorised 400/3/50 unless otherwise stated.

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WARD 1A, 2A, 3A, 7 Capstans, bar feed, collets. From £250.
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ARCHDALE 4 Spindle Drill, No. 3 M.T. Ind. motors. £295.
ARCHDALE S/S No. 4 M.T. Compound table. £225.
HERBERT "C" Type, 2 spindle, 1 geared. £250.
GLEASON 18in. Bevel Gear Planer, 4in. face. £720.
SUNDERLAND 5A, spurs and spirals, 12in. × 4in. × 5 d.p. £695.
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NOBLE & LUND 11/16 Hyd. Saw. Reconditioned. £675.
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Boley 10 Spindle Tapping or Drilling Machine, ¼in. cap., adj. variable speeds. Mot. Also Natco 16 adj. Spindle Drill, 1 M.T., power feeds, mot.—C. L. THOMAS LTD., 18, Park Avenue, Solihull 1281.

Archdale 20in. Horizontal Miller. 400/3/50. 615 r.p.m. max.—HICKS MACHINERY, LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

No. 3U "Adcock & Shipley" motorised all-geared Universal Milling Machine. Table 50in. by 12in., has longl. travel of 30in. Spindle speeds 20-1,400 r.p.m. Auto feed ¼in.-50in. per min. all movements. Rapid traverse by separate motor. Good equipment. Post war machine.—LEE & HUNT, LTD., Crocus Street, Nottingham. Tel.: 84246.

Sheet Metal. Besco Type F Size No. 8 4ft. Slip Bending Rolls. Besco Type SH 42in. Hand Lever Shear, £75. Brookes 8ft. × ¼in. Bending and Folding Machine Handy 1in. Bar Cropping Machine, £10. Handy 1in. Bar Bending Machine, £10.—TATE MACHINE TOOL CO., LTD., 6, North End Parade (opp. Olympia), London, W.14. Telephone: Fulham 6563 (3 lines).

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Selection of Machine Tools from Stock or Early Delivery.

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JONES & SHIPMAN 15in. Two and Three Spindle Drilling Machines, No. 3 Morse Taper spindles, motorised 400/3/50 cycles.

KITCHEN & WADE 4ft. 0in. Sensitive Radial Drilling Machine, two-motor type, box bed, motorised 400/3/50 cycles.

LATHES

NILES TIMESAVER 17in. Centre Heavy Duty Lathe, 13ft. between centres, swing 26in. dia. over saddle, motorised 400/3/50 cycles.

SWIFT 15in. Centre Heavy Duty Lathe, 8ft. 0in. between centres, swing 24in. dia. over saddle, motorised 400/3/50 cycles.

FAIRBAIRN 16in. Centre Heavy Duty Lathe, 15ft. 0in. between centres, swing 23in. dia. over saddle, motorised 400/3/50 cycles.

LANG 15in. Centre Heavy Duty Lathe, 17ft. 6in. between centres, 2 saddles, swing 19in. dia. over saddles, motorised 400/3/50 cycles.

WARD No. 7 Covered Bed Capstan Lathe, arranged chuck work, motorised 400/3/50 cycles.

New **MITCHELL** 12½in. Centre Gap Bed Lathe, admit 8ft. 9in. between centres, motorised 400/3/50 cycles.

HONING MACHINE

KITCHEN & WADE Vertical Hydraulic Honing Machine, capacity 2in. to 9in. dia bores up to 29in. long, motorised 400/3/50 cycles.

SLOTTING MACHINES

BUTLER 14in. stroke Slotting Machine, 39in. dia. indexed rotary table, motorised 400/3/50 cycles.

MUIR 30in. Stroke Heavy Duty Slotting Machine, 50in. × 50in. tilting table, motorised 400/3/50 cycles.

BORING MACHINE

WALDRICH Heavy Duty Vertical Turret Lathe, fitted side head, maximum swing 66in. dia., motorised 400/3/50 cycles.

GRINDING MACHINES

CHURCHILL Model VXA Vertical Spindle Hydraulic Surface Grinder, table 72in. × 16½in., segmental wheel 18in. dia., motorised 400/3/50 cycles.

LUMSDEN Model 91LE Vertical Spindle Rotary Table Surface Grinder, 26in. dia. table, grinding wheel 18in. dia., motorised 400/3/50 cycles.

CHURCHILL Model OSB Horizontal Spindle Hydraulic Surface Grinder, 30in. × 8in. table, motorised 400/3/50 cycles.

CINCINNATI No. 2 Centreless Grinder, Filmatic bearings, motorised 400/3/50 cycles.

NORTON 12in. × 36in. Hydraulic Universal Grinder, motorised 400/3/50 cycles.

PRESSES

BLISS 400 Ton Knuckle Joint Press, stroke 2½in., bed area 20in. × 20in., motorised 400/3/50 cycles.

MILLING MACHINES

ARCHDALE 30in. Vertical Dial Type Milling Machines, table 44in. × 14½in., motorised 400/3/50 cycles.

BOHLE Heavy Duty Dial Type Universal Miller, table 55in. × 14in., motorised 400/3/50 cycles.

ARCHDALE 18in. Horizontal Dial Type Plain Miller, table 30in. × 10in., motorised 400/3/50 cycles.

SHAPING MACHINE

STEPTOE 24in. Heavy Duty Shaping Machine, size of table 24in. × 16in. × 18in. deep. Motorised 400/3/50 cycles.

MISCELLANEOUS

RUSSELL 24in. Hydraulic Cold Metal Sawing Machine cut up to 8½in. rounds, motorised 400/3/50 cycles.

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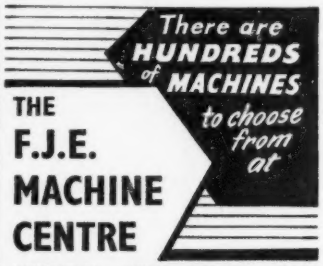

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STANLEY 7in. × 2ft. 10in. B.C. Gap Bed S.S. & S.C. Centre Lathe. 2 speed motor.
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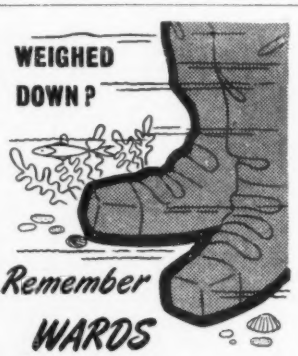

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BORING MACHINES

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FRORIEP Vertical Boring Mill, table diameter, 39in., maximum turning capacity 52in. (1955.)
ASQUITH 7in. Horizontal Floor Boring Machine.
BERTHIEZ Model 9340 Vertical Boring Mill, table diameter 7ft. 10in., maximum turning capacity 9ft. 6in. (1953.)
GIDDINGS & LEWIS No. 56 Horizontal Boring Machine, 6in. travelling spindle, table 60in. by 144in., with outer supports.
JUNGENTHAL Model KE.1200 Vertical Boring Mill, table diameter 39in., maximum turning capacity 50in. (1954.)
NEWALL No. 1 Jig Boring Machine.
New **PFEIFER** Model F.60 Horizontal Universal Boring, Facing, Milling and Drilling Machine, 2¾in. travelling spindle.
NILES Horizontal Boring Machine, 4¾in. travelling spindle, 60in. by 48in. table.
SWIFT Vertical Boring Mill, table diameter 36in.
RICHARDS Vertical Boring Mill, table diameter 36in.

CAPSTAN & CENTRE LATHES

BRADFORD 8¾in. centre height by 30in. between centres Centre Lathe.
HERBERT No. 8 Combination Turret Lathe.
HERBERT No. 12 Combination Turret Lathe with comprehensive tooling.
NILES Centre Lathes 15in. centre height by 28ft. between centres. (Two available.)
BETTS-BRIDGEFORD Centre Lathe, 15in. centre height by 16ft. between centres. (Two available.)
WARD No. 7 Combination Turret Lathe.
GISHOLT Model IL Universal Turret Lathe. (Two available.)
LIBBY Model 4A Capstan Lathe.
OLDFIELD & SCHOFIELD Surfacing and Boring Lathe, 10½in. centre height by 33in.

DRILLING MACHINES

KITCHEN & WADE 28V10 Single Spindle Vertical Drilling Machine, No. 4 M.T.
HETTNER Radial Drilling Machine, having 10ft. Radial Arm elevating column type.
KITCHEN & WADE 4ft. 6in. Radial Drilling Machine.
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ASQUITH OD1 6ft. Radial Drilling Machine.
ARCHDALE Radial Drilling Machine, 3ft. 6in. radial arm.

GEAR MACHINES

MUIR 72in. spur and helical Gear Generating Machine.
KOLB Gear Grinding Machine.
GLEASON No. 9 Bevel Gear Completor Machine.
ORCUTT Model HM.24 Internal Spur Gear Grinding Machine.
SYKES V.10 Gear Generator.
GLEASON 3in. Bevel Gear Generators.

GRINDING MACHINES

New **EXCEL** No. 3 Hydraulic Surface Grinding Machine.
CHURCHILL Universal Grinding Machine, 10in. by 24in. between centres.
B.S.A. LANDIS Type "C" Plain Hydraulic Cylindrical Grinding Machine, 6in. by 30 in. (Two available.)
CHURCHILL Model HBY Internal Grinding Machine.
BLANCHARD No. 10 Vertical Spindle Surface Grinding Machine.
LANDIS Hydraulic Universal Grinding Machine 14in. by 36in. between centres.
LANDIS Type D Hydraulic Crank Pin Grinding Machine capacity 2¼in. by 72in.
LANDIS Type "C" Plain Hydraulic Cylindrical Grdinding Machine, 10in. by 36in.
NORTON 10in. by 18in. Plain Cylindrical Grinding Machine.
ABWOOD Vertical Spindle Surface Grinding Machine, 6in. by 18in.
CHURCHILL Hydraulic Universal Grinding Machine, capacity 24in. by 72in.
New **TOS** Vertical Spindle Hydraulic Surface Grinding Machine, table 118in. by 24in.
New **TOS** Vertical Spindle Hydraulic Surface Grinding Machine, table 59in. by 12in.
New **TOS** Model BBZ.60 Centreless Grinding Machine, maximum capacity 2¾in. diameter.
BROWN & SHARPE No. 22, 10in. by 26in. Plain Hydraulic Cylindrical Grinding Machine.
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CHURCHILL HBA Internal Grinding Machine, arranged for auto sizing.

MILLING MACHINES

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SUNDSTRAND Hydro-Screw Rigidmill Automatic Production Milling Machine, table 78in. by 14in., table traverse 48in.
MILWAUKEE No. 4H Plain Horizontal Milling Machine, table 74in. by 15½in.
VICTOMATIC Automatic Cycle Production Milling Machine, capacity 50in. by 10in.
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REED PRENTICE No. 6 Vertical Milling Machine, table 84in. by 20in.
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CENTEC Model 3R Automatic Production Milling Machine, table 6in. by 25in.
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HERBERT No. 10 Vertical Milling Machine, table 31in. by 9½in.
CINCINNATI No. 2 Dial Type Vertical Milling Machine, table 52½in. by 12½in.

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STOCKBRIDGE 20in. Shaping Machine.
URQUHART LINDSAY & ROBERTSON ORCHAR Spiral Drive Heavy Duty Planing Machine, capacity 16ft. by 5ft. by 5ft.
STIRK HILOPLANE Planing Machine, four solenoid tool boxes, capacity 12ft. by 4ft. by 4ft.

MISCELLANEOUS

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SHEEPBRIDGE 20in./22in. Hydraulic Cold Circular Sawing Machine.
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MACHINE TOOLS

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PENSOTTI 36in. Vertical Borer, side head.
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CINCINNATI No. 2 Vertical Miller, dial type.
ARCHDALE 12in., 18in., 24in. and 30in. Vertical Millers.
CINCINNATI O8 Auto Cycle Millers
KENT OWEN 1-14 Miller.
ARCHDALE 28in. Horizontal Miller.
RICHMOND O3 Universal Miller, 38in. by 9in.
EDGWICK No. 2 Simplimill, 37in. by 12in.

CLEVELAND 2½in. Automatics.
HERBERT No. 5 Auto., 18in. by 3½in.
CONOMATIC ¾in. 4-spindle Automatic.

ASQUITH 5ft. Radial Drill.
KITCHEN & WADE 4ft. 6in. Radial Drill.
ARCHDALE "O" Multi Drill.
POLLARD 12X Multi Drill.
HERBERT Type V Drill.
POLLARD 4-spindle Sensitive Drill.
JONES & SHIPMAN ½in. Tapping Machines.
HULLER No. 3 Radial Tapper.

ORMEROD 26in. Slotter
BETTS 12in. Slotter.

OSTER 6in. Screwing Machine.

SNOW NC14 Face Grinder. 12ft. stroke.
HEALD 72 Sizematic Duplex Internal Grinder.
CHURCHILL HBB Automatic Internal Grinder.
CHURCHILL 8in. by 16in. Semi-Universal Grinder.
CHURCHILL 12in. by 36in. Universal Grinder.
BROWN & SHARPE No. 2 Universal Grinder, 12in. by 30in.
BROWN & SHARPE No. 2 Surface Grinder.
SNOW 24in. by 8in. Surface Grinder.
SNOW T.20 and T.14 Table Surface Grinders.
GARDNER 50in. Disc Grinder.
New **OLIVETTI** 13½in. Swing by 48in. Cylindrical Grinders.
CHURCHILL 18in. by 6in. Plain Grinder.
MULTIMAT 7½in. Capacity Centreless Grinder.
LANDIS 12in. by 32in. Crankshaft Grinder.

NEWALL 10in. by 48in. Model L.A. Hydraulic Cylindrical Grinders.
VAN NORMAN 16in. Raceway Grinders.

New **MITCHELL** 16½in. Lathe, 17ft. 6in between centres.
New **MITCHELL** 14½in. Lathe, 9ft. 9in. between centres.
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WARD O.E. Capstan. Bar feed and tooling.

WARD 7 Capstan. Bar feed and tooling.

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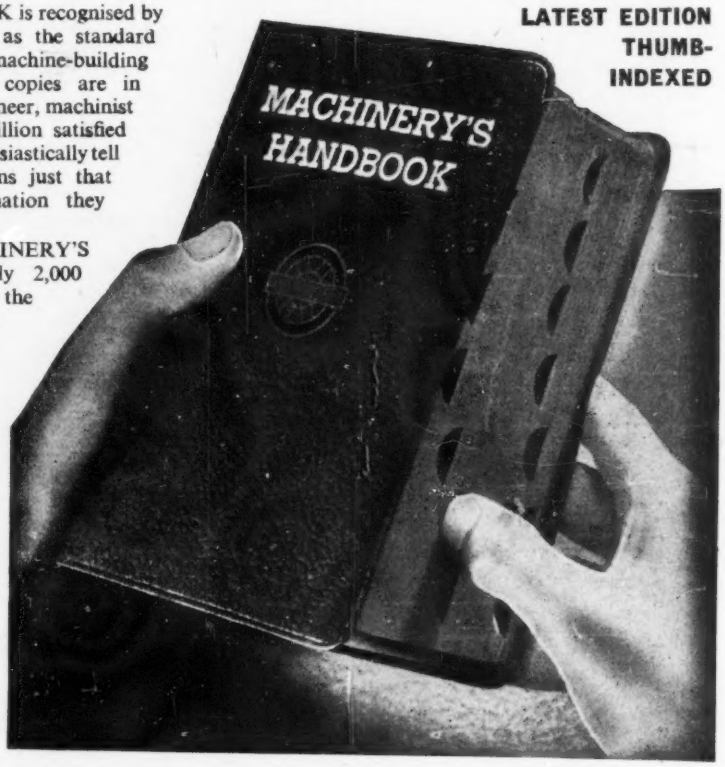

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If you do not wish your reply to any Box No. advertisement in this section to be forwarded to certain firms, please advise us. Your reply will then be destroyed, but you will not be notified as this would disclose the identity of the advertiser.

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Works Manager With Progression to Director required for Press Shop with fabrication and plating departments. Must be fully qualified and have commercial experience. Housing assistance on final acceptance. 40 miles London.—Full details and salary required to BOX Z844, MACHINERY, Clifton House, Euston Road, N.W.1.

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Sound experience in Jig and Fixture design applied to light and medium engineering is required and qualifications to the standard of H.N.C. are desirable.

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Edmonton Works, Angel Road,
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Mark replies "Private" to the Secretary (Donald Hamilton, A.C.A.), Board Appointments Committee, W. E. Sykes Limited, Manor Works, Staines, Middlesex.

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Applications, giving full details of qualifications, experience and present salary (in confidence) to The Personnel Manager, **BOX Z.841, MACHINERY, Clifton House, Euston Road, N.W.1**

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Classified Advertisements (SITUATIONS VACANT, contd.)

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BOX 642, W.S. Crawford Ltd. 233 High Holborn, London, W.C.1.

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REPRESENTATIVES

Free Lance Representative. West Midland Company with capacity available on Automatics, Capstans, Milling and Plain Grinding, wishes to contact representative with good connections, with a view to obtaining suitable work any area. Generous commission. —BOX Z820, MACHINERY, Clifton House, Euston Road, N.W.1.

Machine Tool Representatives Midland Drilling Machine Manufacturer require Technical Sales Representative about 30 years of age for London area and to be first assistant to London Manager. Must have served an Indentured apprenticeship and had some years of selling experience as a Machine Tool Representative. Car provided.—Please give full details of experience and salary to: BOX Z851, MACHINERY, Clifton House, Euston Road, N.W.1.

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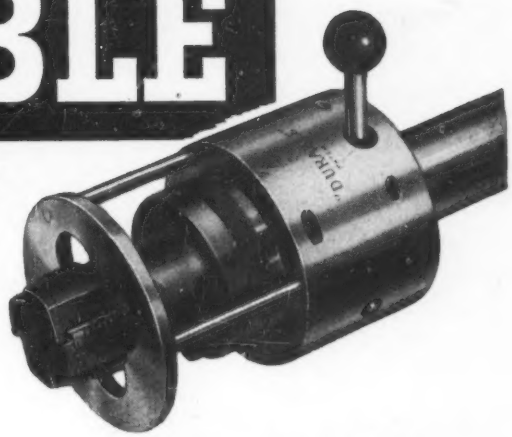

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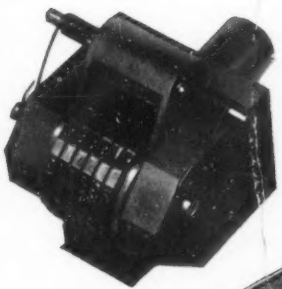

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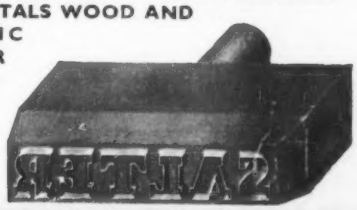

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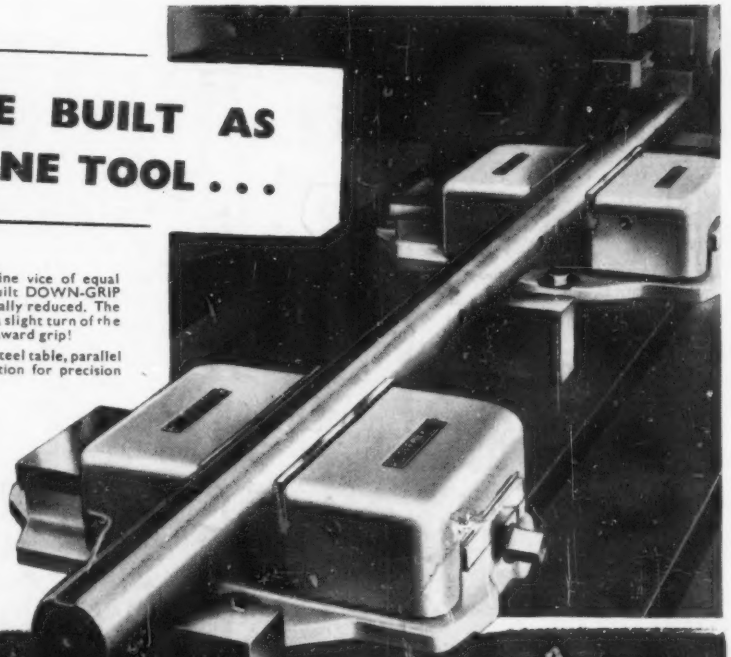

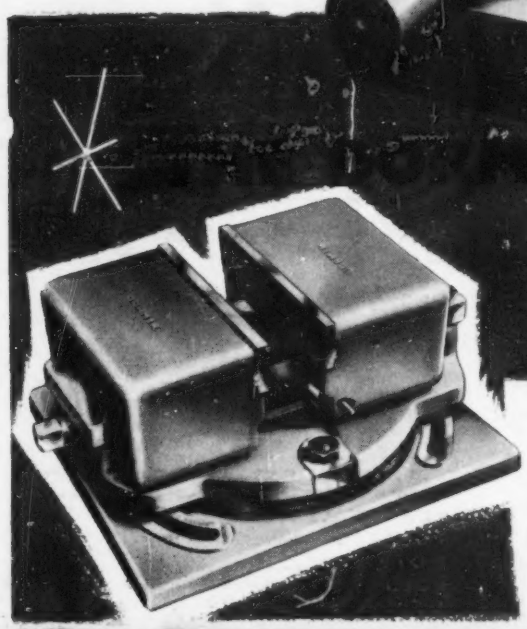

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